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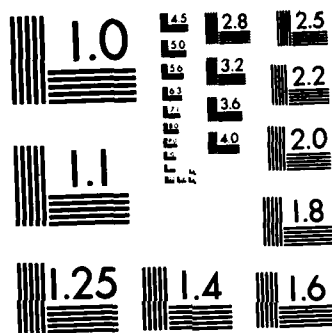
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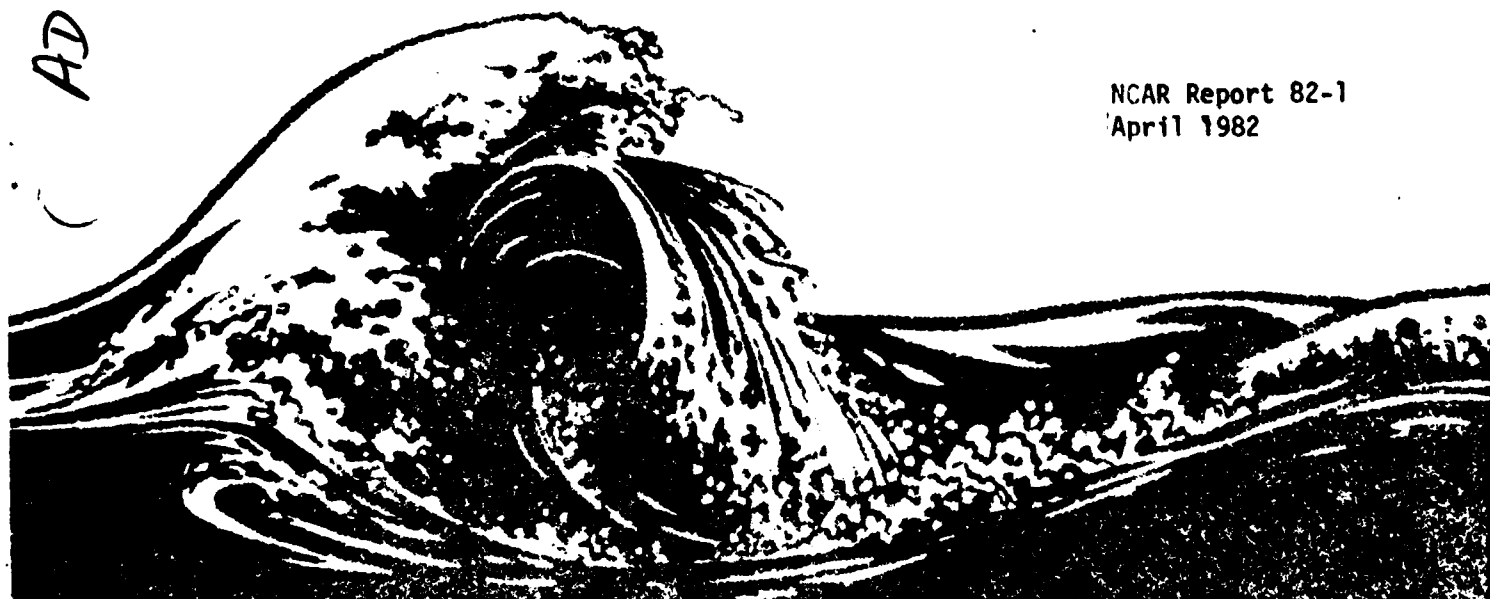
STRATEGIC MANAGEMENT
OF
RESOURCE MARKETS

Ronald L. Schill

and

David V. Lamm

NCAR Report 82-1
April 1982



U. S. NAVY CENTER FOR ACQUISITION RESEARCH



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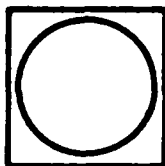
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Executive Director

FOREWORD

The Navy Center for Acquisition Research (NCAR) is chartered with "the dissemination of acquisition research information and data." Under this charter, NCAR publishes reports and working papers that appear useful for distribution to the acquisition community. This report on strategic resource management by Dr. Ronald L. Schill and Commander David V. Lamm is published in this series.

The ability of lower tier suppliers to meet current and long-term requirements of prime defense contractors for strategic resources is the focus of this report. Included in the strategic resources discussed are key materials, technologies and manufacturing capabilities/capacities vital to the supply of major weapon systems programs. The report looks at a cross-section of Department of Defense (DOD) prime contractors to ascertain whether a strategic management system exists and, if so, how effective certain contractor programs have been.

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This report was funded by the Navy Center for Acquisition Research, the Air Force Business Research Management Center and the Naval Postgraduate School, Foundation Research Program. It is issued to assist government and industry in improving their programs in strategic resource management.

JOSEPH H. AUGUSTA
Executive Director
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ABSTRACT

The Department of Defense (DOD) policy-makers, acquisition managers, and others charged with administration of the DOD acquisition process for major weapon systems have expressed concerns about the current and long-term viability of lower tier suppliers in the industrial base for key materials, technologies, and manufacturing capabilities and capacities vital to the supply of major weapons systems acquisition programs. Successful management of these lower tier capabilities focuses on the pivotal role of the prime contractor in providing: (1) strategic long range planning of programs to support DOD major weapons systems requirements, (2) strategic management of the identification and development of external resources necessary for the timely, cost-effective, and quality supply of these weapons systems, and (3) effective programs to manage the risk of dependencies of the prime contractor (and indirectly the Government) on lower tier technological, material, and manufacturing resources so as to assure long-term supply.

This report researched a cross section of DOD prime contractors focusing on (1) the operation and functional content of strategic management systems and their approaches to identifying, prioritizing, and developing marketing programs to compete for DOD weapons systems, (2) the state-of-the-art of strategic material and technological resources in this strategic management process, and (3) the identification of what efforts, if any, prime contractors are doing to entrepreneurally and proactively develop and direct strategic efforts to assure timely, cost-effective, and quality supply of resources from lower tier suppliers.

The study found that most DOD prime contractors are not only performing good strategic planning, but that they are among the leaders in American industry in the state-of-the-art of this management. Their efforts at strategic resource management, however, are quite poor. Such efforts are very sporadic in the aerospace industry and occur largely on an ad hoc, tactical reaction basis toward immediate shortfalls in resources. The practice of materials management/procurement is not functioning well as a part of the strategic management program, but usually functions as a tactical, operating support of the manufacturing function, with efforts at near-term management problems. Strategic resource problems of long-term time-frames, if recognized and articulated by management, are largely seen as constraints to supply of weapons systems. Most materials management organizations do not operate entrepreneurally and proactively in dealing effectively with strategic resource problems. The authors found isolated cases in some companies of programs aimed at effective, proactive strategic resource management of lower tier dependencies on technological, manufacturing, and material resources. Efforts aimed at technological dependencies, improvements in lower tier manufacturing technologies, and production capacities are largely lacking in industry, with only a few firms doing initial efforts in these areas. Critical resource management focuses largely on forecasting, and not effective actions to assure supply. From these findings, this report provides a normative model of how company managements should improve their strategic resource management programs, together with recommendations for changes in policy and the acquisition/source selection procedures within DOD to foster, encourage and demand specific improvements in prime contractor strategic resource management programs focusing on lower tier resource dependencies.

STRATEGIC MANAGEMENT OF RESOURCE MARKETS:
An Exploratory Study of Department of Defense Contractors

by

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Chapter I

STRATEGIC MANAGEMENT SYSTEMS OF DEPARTMENT OF DEFENSE CONTRACTORS: An Introduction

The main purpose of this research project and report is to study and analyze the state-of-the-art among major Department of Defense contractors of strategic management systems pertaining to their resource markets and their immediate and long-term efforts at acquisition of strategic and critical resources. This study and analysis was done for the purpose of assisting key policy-makers within DOD and key Congressional committees both directly and indirectly in their efforts to deal with key problems in the acquisition of strategic and critical resources by the defense industrial base.

Strategic issues, many of which threaten the ability of DOD to acquire effective, affordable and timely delivery of weapons systems, have been identified by DOD managers as key problems for management by the defense industrial base and through acquisition policies taken by the Government. These issues take the form of areas of assessment of both immediate and long term adequacy of members of the defense industrial base in acquiring strategic and critical resources necessary to production of weapons systems.

Strategic management processes utilized by contractors in the defense industrial base become the focus of this research from three perspectives:

- (1) What is the state-of-the-art of strategic management processes utilized by major defense contractors relative to such processes in industry in general?
- (2) What, if any, role do the strategic issues concerning strategic and critical resources play in the contractors' strategic

management systems?

- (3) What, if any, role do selected DOD and other Governmental acquisition policies play in the content and operating processes of strategic management systems of contractors, with particular concern for strategic and critical resources management?

This report presents an in-depth description and analysis of the strategic management of resource market issues among DOD contractors within the context of their overall strategic management systems, and focuses specifically on several key issues of concern to DOD and Congressional leaders concerned with the acquisition process.

Major DOD Concerns on Strategic/Critical Resources

A study of reports, speeches, and memoranda pertaining to strategic and critical resources, and interviews conducted by the authors among key DOD acquisition policy officials indicated two principal categories of concerns with regard to contractor and lower tier organizations:

- (1) Product and technological planning for long-range management by contractors, with emphasis upon DOD market assessment techniques and the ability of contractors to effectively plan for long-range DOD business and major weapons systems projects. This concern focuses on a contractor's ability to...
 - (a) identify long-range mission and weapons systems needs,
 - (b) develop and apply internal and external resources to provide DOD with a high quality set of alternatives for acquisition choices, and
 - (c) provide these choices in an operationally effective, affordable, and timely manner.

Success in this effort requires effective application of strategic management practices among contractor organizations which have been adapted to the realities of the DOD market

environment. These realities include a high technology, high risk environment of political/technical/economic debate and change characterized by the acquisition process as directed by the Constitution and by acquisition policy directives at various levels of Government.

- (2) Contractor assessment of external resource market issues and factors in immediate and long-range management of technological and material resources in such a way that the contractors' efforts and responsibilities in meeting DOD requirements are not hindered by deficiencies and serious problems within lower tier supplier organizations and market structure or by deficiencies in the cost and/or availability of strategic resources. More specifically, this area of concern deals with...
 - (a) non-availability of technologically critical materials used in major weapons systems.
 - (b) inadequate cost containment of technologically critical materials used in these systems,
 - (c) inadequate maintenance of an effective, competitive base of lower tier suppliers,
 - (d) inadequate maintenance of capabilities and capacities to respond to current level and potential surge requirements of DOD by all levels of contractors, and
 - (e) insufficient direction, motivation, and orientation of lower tier supplier organizations by prime contractors concerning strategic resource problems.

With regard to these two concerns, the purpose of this report is to describe and assess both the internal strategic business/technological management processes of major contractors and their external resource market management efforts and relationships with lower tier industries and suppliers concerning strategic issues.

Interviews held with key DOD acquisition managers and policy-makers contained a major concern over the perceived inadequacy and negative trends among lower tier suppliers and their organizational capabilities to provide technological, production, and materials flow in support of major DOD weapons systems needs. This concern is more prevalent in certain segments of the aerospace industry; namely, raw materials availability and cost in general, semiconductors, major forgings and foundries, and highly specialized components used in weapons systems. Evidence leading to these concerns comes from potential non-availability or scarcity of materials due to political uncertainty or competing end market users, rapid cost escalations, decreasing numbers, capacities, and interests among lower tier suppliers, and lengthened lead-times for major forgings.

Since DOD, per se, does not have privity of contract or the ability to conduct direct engagement with lower tier organizations, its efforts are limited to stockpiling or policy change which involves major economic and political problems. Thus, short of major stockpiling and policy changes within law, DOD is interested in what effort, if any, particular major DOD contractors are doing to address these major resource market problems. In particular, how, if at all, does the strategic management process within these contractors serve to identify and effectively deal with lower tier resource market problems?

Diagnostic efforts described to the authors by DOD managers indicated that major sources of concern were over:

- (1) Economic/world geopolitics and industrial structures pertaining directly and indirectly to the supply of strategic and critical materials, production processes, and technical capabilities, and
- (2) Management processes within contractor organizations, particularly strategic management, and its utilization within the procurement/materials management function pertaining to lower tier organizational relationships and the acquisition of strategic and critical technological and material resources.

Within the multiple-tier structure of the aerospace industry, and the defense industrial base in particular, business and technological managers within the lower tier organizations look to prime contractors or higher tier organizations as their immediate sales markets. They look only indirectly at the DOD acquisition process as an end market. Sales are made to and through the higher tier contractor organizations. Thus, the strategic technological, product line, and major weapons systems program planning processes and expectations of these higher tier contractors serve as the markets of interest to the lower tier organizations.

Long-range plans, resource commitments, and priorities of opportunities as seen by lower tier organizations are influenced and shaped by their perception of the long-range plans and product/market/technology commitments of their customer organizations--prime contractors. If these commitments, as they pertain to DOD weapons systems needs, are seen as vague, tentative, or poorly articulated, then a major ingredient of market uncertainty comes to the lower tier organization. On the other hand, if prime contractor organizations do a good job of identifying, prioritizing, and committing resources to long-range DOD weapons systems needs, this, in turn, can serve to strengthen similar commitments by lower tier organizations. Thus, strategic efforts in terms of resource commitments by lower tier organizations are directly dependent upon:

- (1) The quality of strategic management and long-range planning done by prime contractor organizations, and
- (2) The quality and timeliness with which this effort is communicated to potential and current suppliers within the lower tiers, particularly the strategic management role played by the procurement/materials management function in the prime contractor organization.

These two propositions form a fundamental basis of this research. It is not the objective of this research to assess and evaluate whether or not the propositions do, in fact, have this direct impact on lower tiers. Such impact is assumed from indications given by DOD managers and from basic knowledge of industrial market planning theory. The focus of the research is upon describing and analyzing the quality and content of these two propositions, stated thusly:

- (1) DOD contractor organizations at the prime tier level are performing high quality strategic management in terms of process and content relative to the current state-of-the-art of strategic management.
- (2) DOD contractor organizations at the prime tier level include high quality strategic management in process and content pertaining to resource market issues and strategic supplier relationships.

A corollary to proposition two is:

- (2a) DOD contractor organizations at the prime tier level include emphasis upon key strategic and critical resource issues of concern to DOD within their strategic management process and content, and this inclusion is done in a proactive, entrepreneurial manner.

Conceptual factors and definitions within these propositions will be developed and explained in depth in later chapters of this report. The major emphasis here is that:

DOD PRIME CONTRACTORS ARE AWARE OF THE STRATEGIC AND CRITICAL RESOURCE CONCERNS OF THE DEPARTMENT OF DEFENSE, SPECIFICALLY THOSE LISTED IN THE ABOVE DISCUSSION. FURTHER, THESE CONTRACTORS NOT ONLY ADDRESS THESE CONCERNS AS PART OF THEIR OWN STRATEGIC MANAGEMENT EFFORT, BUT THEY TAKE ACTIVE STEPS TO ADDRESS THESE PROBLEMS SO THEY WILL NOT MATERIALLY HINDER THEIR DELIVERY OF EFFECTIVE, AFFORDABLE AND TIMELY DELIVERABLE WEAPONS SYSTEMS.

Several of the DOD managers and policy makers interviewed by the authors noted that they were totally unaware of any such effects either underway or contemplated by prime contractors. They also indicated that a common response that they had received from questions of this sort that had been posed to contractor personnel was that DOD and the Congressional budget process was to blame for lower tier and strategic and critical resource market problems. Although this may be true in that uncertainties and delays in weapons systems decision-making and budget processes may be a contributing factor to strategic management problems of prime contractors, this is not necessarily an excuse for the contractors to (1) not take strategic actions on resource market problems by blaming DOD, and/or (2) take actions which do not utilize effective strategic management

techniques and entrepreneurial efforts.

Major initiatives within DOD to address problems in acquisition policy, such as more use of multi-year contracts, changes in profit determination and incentives, and resource stockpiling, may provide substantive correction to many of the resource market concerns. However, this does not excuse prudent corporate managers and planners from taking an important role in addressing lower tier and resource market problems. The DOD acquisition process, including its opportunities and problems, is part of the market task environment of the contractor organizations. Finding and developing effective strategic ways of dealing with issues of uncertainty of direction and commitment, without allowing these issues to materially influence resource sufficiency or cost, becomes an important creative management challenge to contractor organizations.

Looking from the other end of the supply channel, the authors do not wish to deny the role of prudent lower tier managers in doing effective strategic management. However, their task is complicated by inadequacies in the strategic management process within higher tier market organizations, including prime contractors and DOD acquisition organizations. Furthermore, many of the smaller lower tier organizations do not possess the management skills and staff to do adequate strategic management, and are largely technologically-driven. They are functionally dependent upon their customer organizations for indirect management. Where a lower tier supplier is a large organization, such as Westinghouse supplying General Electric, the lower tier organization can be held as accountable as the buyer for strategic management, due to its size and its role as prime contractor on some programs.

When lower tier organizations, particularly smaller ones, experience inadequate or continually frustrating relationships with prime contractor customers, this can lead to decisions to diversify into other business areas, drop a product or technology line, or take other negative actions detrimental to the supply needs of DOD weapons systems. A major

contributing factor to a situation of frustration and concern is the characteristic high technology and low volume requirements of many DOD projects, particularly in light of cost inflation and budget cuts. However, if the prime contractors do not functionally manage this problem they, as well as DOD, are losers of the important specialized capabilities of lower tier organizations.

In conclusion, it is a major operating proposition of this report, as indicated by DOD managers, that:

THE ADEQUACY AND PERFORMANCE OF THE LOWER TIER INDUSTRIAL BASE ORGANIZATIONS IS DIRECTLY AND INDIRECTLY INFLUENCED BY THEIR MANAGEMENT'S PERCEPTIONS OF THE COMPETENCY, THOROUGHNESS, AND QUALITY OF STRATEGIC MANAGEMENT EFFORTS OF PRIME CONTRACTORS RELATIVE TO DOD ACQUISITIONS AND THE OPPORTUNITIES OF THE PRIME TIER ORGANIZATIONS AS A VIABLE MARKETPLACE FOR THE LOWER TIER ORGANIZATIONS.

This proposition would make an excellent thesis for additional research, but is assumed as operational in this research. The focus of this research comes from it and is aimed at assessing the competency, thoroughness, and quality of strategic management efforts of prime contractors, with emphasis on the resource market issues.

Role of Prime Tier Contractors

The research takes the focus that the role of the prime tier contractor is one of risk shelter between the DOD acquisition agencies and the lower tier organizations. This risk shelter pertains to technological and business risks. Prime contractor organizations which are seen by lower tier organizations as having good "track records" in forecasting and committing to DOD weapons systems programs which did prove to be survivable of acquisition decisions and budgeting processes, and on which the prime contractor was a winner of contract awards, play a key role in risk reduction as customers of the lower tier companies.

If such prime contractors do not do an effective job in identifying,

prioritizing and developing DOD weapons systems opportunities, they would, conversely, be seen as poor risk managers. Under such a risk relationship, lower tier managers may well be hesitant to commit their own resources toward such a vague and tentative customer.

Thus, in order to provide effective risk of business commitment toward the expectations of a potential weapons system coming to fruition, among lower tier organizations, prime tier organizations must have effective and competent strategic market management and planning--particularly with a good track record of commitments. This necessitates a good quality strategic management process.

However, the role of the prime tier contractor does not end with sales market planning and strategic management. Even with an effective program, lower tier organizations may not respond with effective levels and content of support in providing resources. This may be due to perceptual problems vis a vis the prime tier contractor, or merely to decisions to orient priorities toward non-DOD markets. In this situation, it becomes part of the role of the prime tier contractor to be entrepreneurial and proactive in developing and committing the support of needed lower tier suppliers of technological and material resources. An attitude of "we'll have to take what we get" from the lower tiers, on the part of the prime tier organization, can result in ineffective and costly delivery of weapons systems to DOD. Consequently, the resource market management function within the prime contractor must:

- (1) Operate in a strategic management mode, and
- (2) Utilize proactive, entrepreneurial initiatives to address strategic inadequacies and concerns within resource markets.

Nearly all DOD managers interviewed expressed this as a strong desire and appropriate role of prime tier contractors. None indicated whether or not it occurred within contractors, and most indicated that it was not occurring. Is this perception correct? That is part of the role of this research to determine if it is correct. If such effort is occurring, what specifically is occurring? If it is not occurring, why not?

Research Questions and Methodology

Whether or not the reader agrees or disagrees with the propositions or interpretations noted in the preceding sections of this chapter, the authors present a major research effort which was aimed at describing and analyzing just what strategic management efforts are occurring within a sample of prime tier contractors, and what, if any, direct and indirect proactive, entrepreneurial actions are being taken toward lower tier and resource market organizations.

The issues developed earlier in this chapter provides a "theoretical role" of the prime contractor toward the process of strategic management within the context of perceived lower tier and resource market concerns of DOD. They also presented the perceived role of prime contractors among DOD managers interviewed prior to the commencement of data collection among contractors. Clearly the theoretical role and the DOD perceived role are very different. DOD managers, in general, are very critical of the competency and commitment of prime tier contractors, specifically regarding their efforts at proactive, entrepreneurial strategic management of resource market problems. Is there a basis for truth in this perception? That is a goal of the research.

In all likelihood, differences between the theoretical role and the perceived role will vary among contractors. Some will be operating closer to the theoretical role while others will fall into the perceived role. The "actual role" with respect to strategic management, is expected to have varying degrees of content and process of strategic management among specific contractors.

The research measured and developed a comprehensive analysis of the actual role pertaining to the strategic management process among a sampling of prime tier contractors and major second tier organizations. Emphasis was upon the resource market aspects of this role.

Research Questions

The research sought answers to the following questions:

- (1) Since strategic planning, and in particular strategic resource market planning, has developed as a major administrative practice, and has evolved into strategic management within the past ten years, are DOD prime tier contractor organizations proficient in implementing it? More specifically, is this implementation occurring within the aerospace/military products divisions of these companies? If so, what aspects of strategic planning/management are being implemented?
- (2) Since it is expected that not all companies will utilize and implement strategic planning/management with the same skill, content and commitment, what suggested improvements can come from a study of the approaches used by the more proficient companies? Can these serve to improve the management processes of other companies, further down on the strategic planning/management implementation cycle?
- (3) Does the strategic planning/management process occurring within some prime tier contractors include issues in resource market management, particularly strategic and critical resources issues? If so, are these issues addressed in a proactive, entrepreneurial manner or merely a tactical, operating manner? That is, are companies taking actions within five year plans to address strategic resource concerns and are they taking actions with suppliers to resolve problems before they become constraints to effective DOD weapons systems delivery? Or are they merely accepting the problems as limitations and constraints in their operating environment?*
- (4) Is the same level of quality and attention being paid to resource market strategic management as to sales market strategic management?

*Specific issues of concern as identified by DOD are critical materials availability and pricing, production process capacities and lead times, structure and competitiveness of lower tier industries, manufacturing technology and productivity improvements within lower tiers, and direction and influence of lower tier, specialized and supporting technologies- especially within an A-109 technological competition format.

Research Methodology

The research presented in this report involved four phases. Phase I involved investigation of literature to provide a theoretical basis of the state-of-the-art in strategic management. Phase II involved investigation of two issues among DOD acquisition managers and policy-makers: First, their identification of strategic issues involving problems in resource markets supporting weapons systems production. These issues became the focus of concern regarding the content of strategic management efforts among prime tier contractors. Second, these managers and policy-makers were asked about their knowledge and perception of the state of strategic management practices among DOD prime tier contractors and in particular resource market management practices. The results of this phase provides for the differentiation between the theoretical and perceived modes discussed earlier in this chapter and a basis for specific questions asked in phase III.

Phase III involved interviews with strategic planners, market managers, environmental forecasters, and procurement managers in a cross section of prime tier contractors and major first tier subcontractors. These interviews, conducted by one of the authors, investigated the nature and content of the strategic management processes used for the DOD market, similar commercial markets, and in particular the role of the procurement function and resource market issues in these processes. Phase IV involved the written description and analysis of the findings of the interviews in industry.

Over thirty senior DOD managers and policy-makers were interviewed in the following agencies:

Department of Defense (Acquisition Policy)	Aeronautical Systems Div.
Federal Acquisition Institute	Electronic Systems Div.
Office of Federal Procurement Policy	Space and Missile Systems Organization
Naval Materiel Command	
Naval Air Systems Command	
Naval Electronic Systems Command	
Air Force Systems Command	

Phase III involved interviews with over two hundred managers and staff personnel in forty companies and divisions of companies. Contractor organizations participating in this phase were:

Boeing Company (Commercial and Military Companies/Divisions)
Honeywell Defense Systems Division
Rockwell, International
TRW Systems, Inc.
Teledyne Ryan Aeronautical
Sperry-Rand
Raytheon Company, Missile Systems Division
E Systems
ECI Division, E Systems
General Electric
General Electric, Aerospace
General Electric, Medical Systems
General Electric, Aircraft Equipment
General Electric, Engines
Pratt & Whitney Aircraft Group
IBM Federal Systems Division
McDonnell-Douglas Corp.
McDonnell-Douglas, McDonnell Aircraft Company
Douglas Aircraft Company
McDonnell-Douglas, Astronautics Huntington Beach/St. Louis
General Dynamics
General Dynamics, Fort Worth Division
General Dynamics, Electronic Systems
General Dynamics, Pomona Division
General Dynamics, Convair Division
Lockheed-California
Texas Instruments and Division
Hughes Aircraft Company (several divisions)

In several of these companies, interviews were held at two-three different groups, strategic business units, or product management offices.

Conclusion

The objectives of this report are:

- (1) To improve the management process within contractor organizations by sharing with contractor managers and staff personnel the findings of the state-of-the-art, techniques, and procedures used in strategic planning and management as applied to the DOD marketplace. This will be done by providing copies of this report to managers in each of the participating companies.
- (2) To provide a basis for improving the resource market strategic management process in particular by providing examples of the proactive, entrepreneurial efforts to address key issues in resources markets which are occurring within selected companies, and by providing suggestions to improve the strategic management perspective and process of the resource market management function similar to that practice in the sales market side of operations.
- (3) To provide DOD managers and policy-makers with information, descriptions and analysis of the strategic management processes of contractors so that they may better appreciate and understand these processes and the role that policy and acquisition efforts play in facilitating or hindering this process in contractor organizations. Hopefully, this may lead to policy changes or changes in acquisition practice as suggested by contractor personnel and reported in the body of this research study.
- (4) To provide conceptual and empirical materials for instruction of DOD personnel, particularly personnel attending postgraduate education at AFIT, Naval Postgraduate School, and Defense Systems Management School, who will be participants in acquisition management.
- (5) To provide a basis for further research into other phases and aspects of the problem of resource market strategic management.

SECTIONS OF THE REPORT

The reader is directed to the fact that this report is divided into two sections: strategic management, and strategic resource market management. Section one focuses upon description and analysis of the strategic management process, aimed largely at the sales market and the orientation of the organization toward opportunities and threats in that market. Section two focuses on the procurement/materials management function and strategic management pertaining to resource markets.

Within each section, materials are also devoted either to theoretical development of management processes or descriptions of research findings among contractor organizations. Interested readers can focus their efforts in whatever sections meet their needs. For those well versed in strategic management, skimming of section one is advised. Since section two provides both innovative theoretical development of strategic resource market management and description of industry practices, it is recommended that all readers examine this section. Those interested more in "what is happening" rather than "what should be happening" can focus on descriptive, rather than conceptual chapters in these sections.

Those interested only in management or policy implications are directed to the concluding chapter of the report.

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Section One
STRATEGIC MANAGEMENT

Chapter II
STRATEGIC MANAGEMENT:
An Introduction

Planning, in particular strategic planning, from a managerial perspective may be broadly defined as "a process of deciding what to do, why, and how to do it before some action is required." Planning involves a common set of managerial activities, which include:

- (1) Orientation and perspectives toward the planning environment, assumptions, opportunities, and problems in forecasting and assessing the internal and external factors to the organization influencing the planning process.
- (2) Providing direction in missions, setting of goals and objectives.
- (3) Designing and assessing alternative courses of action and programs/projects to achieve the mission, goals and objectives.
- (4) Developing an implementation procedure and schedule, including the capability of taking contingent actions and redirection as necessary, and providing an effective mechanism for performance assessment.

Managerial planning focuses attention on identifying and addressing major decisions in an analytical and systematic manner before they become crises and serve as major constraints to organizational success. Through the planning process, management can develop a deeper understanding of its organizational and environmental dependencies and interfaces, and many planners believe that the process and discipline of planning is as important as the output--a plan.

This chapter presents conceptual models of strategic management and a key ingredient, strategic planning, from literature and from interviews with managements in the participating aerospace companies. No one company was found doing all of the things discussed in this chapter.

The chapter presents a conceptual state-of-the-art from the aerospace industry as a whole, an editing of the "best situations" found by the authors, but the overall focus and procedures in this chapter provides a good representation of the strategic management process found in the defense industrial base as a whole.

The Development of Strategic Management

Much of the materials provided in this section "The Development of Strategic Management" was taken from materials provided by the General Electric Company, although many of the techniques and processes discussed were found to be occurring within most of the major companies visited. General Electric is given credit for having presented the most thorough background material on the processes and also as a recognized pioneer in this management technique in industry.

Historic Evolution of Strategic Management

Typically, management strategies in companies focus on the objective of quality earnings growth and high returns. To accomplish this, a company must become involved in considerable diversity, often through a decentralized structure. This brings about the need for effective strategic management systems.

The decade of the 1960s saw considerable decentralization of company management with the principal aim being diversified growth. Aerospace companies were not immune to this, as one examines their annual reports during this period of time. Profit center structuring evolved in the organization, with a common goal of having an organization that was "big enough for a person to get his/her arms around."

As departments proliferated, this provided increased span of control in management. These systems of the 1960s saw profitless growth in many companies. Sales growth did occur, but earnings per share and return on investment often did not track well during the growth. Problems developed through the competition for resources among

departments and there developed a need for comparative appraisal of the potential for businesses during resource allocations. Not all businesses were seen as having a need for selective growth.

During the decade of the 1970s, the process of strategic business planning came into vogue. The move was from decentralization for diversified growth toward strategic business units (SBUs) for planned and managed growth. This planning structure was typified and coined largely by GE. The planning process focused on differentiated resource allocations and management styles. Criteria used by GE in selecting SBUs for organizational status were:

- (1) No particular physical size or level in the company for an SBU.
- (2) Unique mission of the organizational unit relative to others
- (3) Identifiable competitors and external market focus points
- (4) Control of business elements within the same unit.

From this approach, SBUs developed the first strategic plans in the company for review and resource allocations. The planning process became an annual effort as shown in the diagram below:

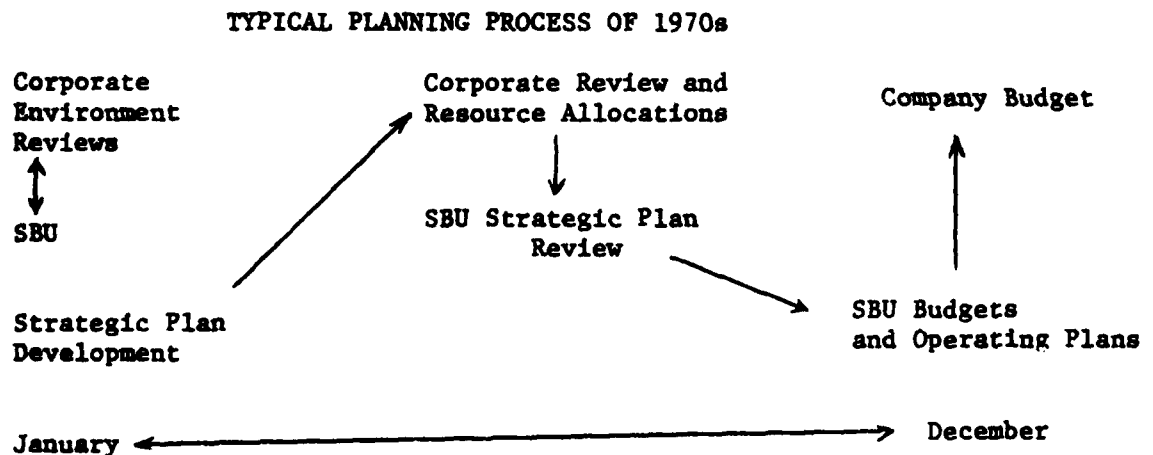


Figure 2: Initial phase of strategic planning processes.

Characteristics of this process were:

- (1) the use of corporate level assumptions and environmental forecasts,
- (2) the use of strategy development review within the budgeting process and phases,
- (3) the use of line management in strategy development (SBU managers),
- (4) corporate involvement in review during resource allocations,
- (5) linkage of strategy formulation with budget approvals, and
- (6) periodic updating of strategic plans.

The process of strategic planning involved the development and implementation of several analytical constructs. Space does not permit examples of all of these, but some of the more popular ones are shown in Figure 2.

GE Strategic Planning Constructs

1. Investment Priority Matrix.

		Market Industry Attractiveness		
		High	Medium	Low
Marketer's Business Strengths	High			
	Medium			
	Low			

Cell Strategies:

High/High: Invest and grow with opportunity
Med/Med or
Low/Med or Selectively grow/selective earnings
Med/Low
Low/Low: Harvest and divest

2. GE Stoplight Strategy in Planning

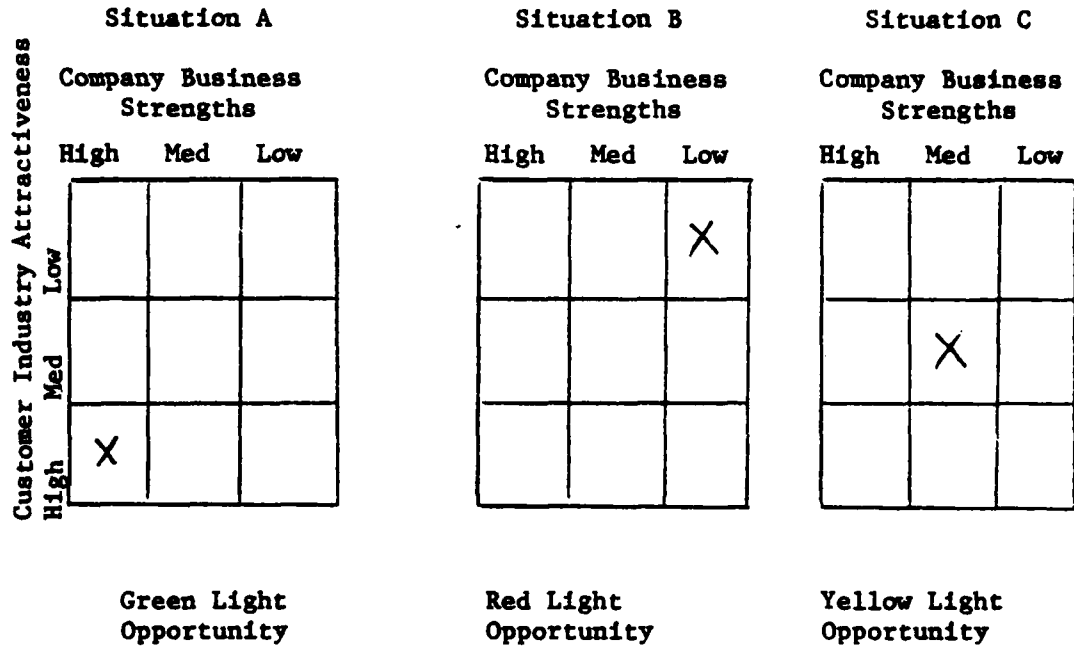


Figure 2: Examples of early GE analytical constructs in strategic planning

The first construct in Figure 2 operates as a business screen and is used to evaluate sales opportunities (such as DOD programs) in making differentiated resource allocations. It arrays business opportunities according to their (1) attractiveness among other opportunities, and (2) their fit to company business strengths. This establishes an investment priority according to the relative appraisal of opportunities.

The second construct involves the application of explicit business strengths and market attractiveness, as in the first construct, but it involves the application of a stop, caution, or go judgment.

These construct approaches provide for a multi-factor assessment of business opportunities against business strengths. However, with the recognition of the dynamic nature of forces came the need for including environmental shifts in the analysis. Both internal and external environmental shifts may be applied. Internal ones include investment utilization, vertical integration, productivity issues; while external forces include inflation vulnerability, cyclicity of industry, or energy impact.

The result of this approach was that during the 1970s, several companies using this approach in strategic planning gained:

- (1) Differentiated cost control, largely through commitment of employee resources according to screen position of opportunities.
- (2) Differentiated program investments, particularly in new product developments, market development, and facility improvements.
- (3) Differentiated marketing performance, particularly in application of what later became known as the inflation recovery index.
- (4) Differentiated investment allocations toward stronger opportunities.

Implications for DOD customers are that DOD programs and prospective programs fall within the opportunity classifications and must compete for resources within this approach, regardless of the impact of statute or policy on contracting and acquisition procedures.

The financial results during the 1970s compared with a 1962 index of 100 (in GE), were improvements in sales by 1978 to an index number of 370, improvements in earnings per share (EPS) to 360, and improvements in return on investment to 120. EPS growth achieved parallel change with sales growth, a key problem in the 1960s.

According to GE analysts, this approach allowed for more streamlined product/market portfolios, more concentration of resources on effective and productive areas, containment of more risks, and enhanced potential for future development. The exercise also developed within the company a cadre of strategic thinkers for the future. The company also learned

that the decentralization through SBUs, controlled and disciplined through strategic planning, provides motivated and growing people, profitable growth, and change of management style.

Strategic Management in the 1980s

Where do we go from here? In the 1980s, management strategy is emerging from strategic planning toward what is termed strategic management, of which planning is only one part.

Organizationally, business is grouped into sectors, which are macrobusiness aggregations of SBUs with similar strategic challenges. Use of the sector level escalates the strategic response beyond SBU capability. Wherein SBUs compete at the business level (company to company), competition at the sector is industry to industry. Corporate sector competitive analysis focuses on multi-industry issues and multinational/global perspectives. Between sector levels, in large sectors, is the organizational level of groups. Groups are aggregates of SBUs with several groups in a sector.

Strategic planning occurs at all three levels through basic development at the SBU level and aggregation and integration at the group and sector level. This process will be discussed in more detail in a later chapter.

Elements of Strategic Management

Strategic management includes several elements which will be discussed in turn: (1) organizational mission, (2) environmental assessment, (3) competitor assessment, (3) resource assessment, (4) strategic planning issues and challenges, (5) objectives and goals, (6) strategies, (7) resource programs, (8) business development programs, (9) financial projections and budgets, (10) contingency plans*

*The authors have chosen to modify this list of elements from the GE approach to include elements of other major programs found among aerospace companies.

Mission Development

Mission is not a term unknown to DOD managers. Mission development serves to focus a universality of outlook by managers. A mission is an overarching, guiding step in planning which examines the hierarchy of business aims. Contractor organizations typically have a variety of mission statements, ranging from lofty goals such as social responsibility to mundane product performance missions. A mission defines the arena in which the business will operate, the benefits it will provide.

A note on DOD acquisition strategy is needed here before going on. The acquisition strategy embraced by directive A-109 directs the need for contractor missions toward providing a maximum of technical performance choices to the customer, a diversity of potential solutions. This may or may not coincide with the mission statements of contractors, who may see themselves competing more in one line of technology, such as airframes. The authors found much reluctance to adopt diversified mission statements, and typical responses by company managers included the notion that if such technological competition occurs, it will be between companies, not between proposals of one company. Few exceptions occurred in companies with diversified divisions, such as in space, aircraft, missiles, or watercraft.

A typical starting point in mission development and choices is a matrix of products/programs and markets, or in the DOD/aerospace arena-- systems and programs. One axis of the matrix identifies DOD markets, such as tactical air support, command and control or antisubmarine warfare activity. The other axis identifies programs within DOD cycles addressing mission needs in these market areas. This is illustrated in Figure 3.

The example shows that a contractor presently would be examining five DOD mission need areas, designated as A-E. Within these areas, the company has directed active product/program efforts in some and has planned effort in others. In others it has no effort, current or planned. These decisions are often heavily influenced by application of the

Planning Matrix for DOD Programs

X Current effort

* Planned effort

		DOD Mission Need Areas					
		A	B	C	D	E	F
Products/ Programs	5	X	*		*		
	4		X	X	X		
	3	*	*		X	*	
	2				*	*	
	1			X	X	X	

Figure 3: Mission need areas and company program efforts.

industry attractiveness and business strengths matrix discussed earlier. In mission need area A, the company has one program on-going and one planned, in B it has two active and two planned, and so forth. The term active might include a currently funded DOD program in an acquisition cycle phase, while a planned program might include one not yet to a DSARC I phase.*

Ideally, mission need areas are broader than the proposed and current offerings of the contractor to encourage growth. One conceptual approach to this is termed "served market," programs currently being

*For definitions of standard DOD acronyms the reader is directed to consult DOD literature. This report is written for DOD acquisition managers and policy makers and managers operating in DOD product areas of companies, judged as familiar with basic DOD acronym terminology.

marketed in production or research and development, and "market of interest," markets of potential involvement of which the served market is only a portion.

From such an analysis some of the contractors develop a statement of mission elements, such as:

- (1) Provide US defense agencies with tactical aircraft systems.
- (2) Extend current aircraft systems into foreign military sales.
- (3) Developed advanced FSW aircraft for the future (forward swept wing).

Since the mission needs of the custom and the technologies and other business strengths of the contractor are both dynamic, there is a need for modifiable, renewable mission statements. Each year this provides a planning challenge. This challenge results from information obtained through environmental analysis.

Environmental Analysis

Environmental analysis includes facts, assumptions, opportunities, and threats coming from the internal and external environments. This occurs through systematic examination of conditions which have and/or will affect the performance and conduct of business and the attainment of mission elements. Such an analysis examines both the macroenvironment and the microenvironment. Within the macroenvironment is the economy, society, government, and technology, whereas within the microenvironment is the specific DOD agencies, congress, competitors, the industry as a whole, and suppliers, as well as other organizations.

The essential question of environmental analysis can be committed to a matrix construct, as shown in Figure 4. Microenvironmental elements are contrasted with macroenvironmental elements to develop important opportunities and threats. Analysis proceeds by examining the matrix horizontally and vertically for interactions.

MACROENVIRONMENT				
MICROENVIRONMENT	Economy	Society	Government	Technology
DOD market	O,T			
Customer agencies				O,T,T
Congress Actions				
Competition	O,T			
Industry				
Suppliers			T,T	

O: opportunity, T: threat

Figure 4: Macroenvironmental/microenvironmental analysis

For example, within the economy, government, and technology elements the environmental analyst may see:

- U.S. currency will weaken xxx\$ by 19--.
- Congress will place increasing value on affordability and life cycle cost.
- System operational technical capability will achieve a specific standard by 19--.
- Microelectronic costs will cross electromechanical costs by 19--.

Such macroenvironment issues may impact microeconomic elements. This may result in congressional actions, changes in acquisition policies, competitive moves, or perhaps changes in supplier support.

What results from this? Environmental scenarios or interpretations provide opportunities or threats within the matrix which require analysis and strategic response within the planning cycle. Managers must make confidence judgments about each assumption. Low confidence assumptions, such as about the currency value in 19--, have less impact on planning. High confidence assumptions, such as predicted policies in government, might have a higher weight in analysis. These situational scenarios become planning challenges for managers. The planning challenges are provided from the corporate office in the form of planning guidelines for the year, and some examples of current challenges are cost containment and

and improved technical and economic productivity. An example of the interperative flow process is shown below:

- Assumption: U.S. currency will weaken to XXX \$ by 19--.
- Opportunities: Increased share of industry profits going to
1. foreign military sales or foreign based operations.
Need for teaming agreements abroad.
- Threats: Increased commitment by foreign firms to U.S. defense market via investment in manufacturing facilities. Diminished cost advantage over of domestic competitors.
- Assumption: Increased interest in "affordability dimension" of systems.
2. Opportunity: Continued demand for derivatives of current systems.
Threat: Quality differentiation by technology is reduced in the mind of customer.
- Assumption: Microelectronic costs will cross electromechanical costs in 19--.
3. Opportunity: Added electronic functions permit differentiation and meet affordability criterion.
Threat: Electronics suppliers become competitors, introduce preemptive pricing practices.

Management must make an impact and criticality judgment on these situational scenarios, and high impact and high criticality ones will become areas for development of specific strategies. A major factor in the ability of the company to respond to the opportunities and threats is its endowment and access to resources.

Resource Analysis

Resource analysis, like environmental analysis, is built upon assumptions based on the analysis of information. The resource analysis, which focuses largely on internal resources in the companies that were studied, provides strengths and weaknesses in responding to the environmentally-imposed opportunities and threats. Resource analysis is a systematic self-appraisal of the present and future competence and ability of the company (and perhaps even its suppliers)

to respond effectively to environmental factors. Much of the resource analysis involves functional planning as opposed to line planning.

The planning discussed and developed so far has been that of line managers, those responsible for the operation of profit centers such as SBUs. Functional managers, those responsible for areas such as production, procurement, finance, engineering, and others must also provide a strategic, long-range appraisal of resource capabilities and needs. When such information is provided to line/SBU managers it can be interpreted to identify areas of resource abundance and/or deficiencies.

Such resources were classified by one company as the following organizational abilities: conceive/design, produce, market, finance, and manage. These were then arrayed with the environmental factors as is shown in Figure 5.

Environmental Factors:	Contractor Organization's Ability to:				
	Conceive/Design	Produce	Market	Finance	Manage
Opportunities					
1.	X				
2.		X			
Threats					
A.			X		
B.					X

Figure 5: Resource assessments contrasted with environmental factors

Resource deficiencies are indicated by "X's" in Figure 5, as they may pertain to specific opportunities and threats. For example, deficiencies in human resources in an engineering technology may hinder the ability to

respond to opportunity #1, whereas opportunity #2 is hindered by a production deficiency, perhaps obsolete manufacturing technology. Further, threat A may not be countered by inability of the company to market in, say, Middle East countries, while threat B is of concern due to a financial constraint, such as R&D funds in a specific line of business.

Approaching the matrix vertically allows management to search for strengths and limitations for each "ability to" category with respect to environmental opportunities and threats. The outcome may be a change of mission orientation or strategies toward missions. Specific strengths and limitations should be noted, such as:

Strength: Company holds a Navy contract for research on energy systems. Important conceive/design and finance ability pertaining to a specific opportunity.

Strength: New robotics facility in place by 1985. Ability to produce to meet affordability criterion.

Limitation: Present R&D strength will be diminished by key retirements in the next decade. May limit ability to respond to the growth opportunities in a program area.

Limitation: Commercial product technologies limited in applicability to defense customers. Cannot conceive and design in emerging defense need.

A major factor in the interpretation of abilities to respond to environmental factors is the analysis of competitors.

Competitor Analysis

Competitor analysis includes the identification of environmental assumptions, opportunities and threats for competitors, analysis of competitor resources and product/program strategies, with the same degree of attention and interest as the company doing the analysis looks at its own operations. The only possible difference is in the amount and quality of information. The *raison d'être* of strategic planning is the achievement of competitive advantage. This requires knowledge, or at least assumptions,

about competitors' current and future capabilities and directions. This involves the systematic examination of competitors, individually and collectively, to determine their strengths and weaknesses in the same areas discussed above for the company doing the analysis.

Competitors and competition within the aerospace market are considered within competitive classes. These may include:

- (1) Present competitors for specific programs.
- (2) Firms that fulfill the same customer/mission need in an alternative manner--ala A-109, such as cruise missile versus manned bomber.
- (3) Foreign firms with world market strategies (Airbus)
- (4) Suppliers with forward integration strategies
- (5) Higher tier customers with backward integration strategies
- (6) Firms with diversification strategies in neighboring industries
- (7) Firms that compete for the customer's funding budget in other areas.

This competitor analysis provides iterative information to judgments of criticality and importance to the firm's own strategic response to environmental opportunities and threats. For example:

- A firm's strength of commercial patent protection may be neutralized by a competitor's strength in an alternative technology.
- A business's limitations of an aging plant may be accentuated by a competitor's new plant.
- A business's strength in technical R&D work may be reinforced by a competitor's dependency on suppliers or teaming agreements for those same strengths.
- A limitation imposed by corporate investment priorities may become crippling against a competitor's access to corporate funds.

The results of competitor analysis may provide a scenario such as the following:

Announced objective of competitor is to double sales and income in five years. Principal growth has and will come from worldwide acquisitions. Employ multiple programs. Participate in all product segments of sea systems.

Objective is to meet corporate standards of profitability. Denied major investment funds. Consolidating facilities, and retrench for cost reduction. Focus resources on growth programs.

Rewritten environmental analysis may include:

- (1) Several competitors are planning to add capacity. Pricing may be chaotic.
- (2) No competitor has design or production experience in composites.
- (3) No competitor looking for laser application in information transmission for military needs.

The competitor is seen as part of the operating environment in this instance because of strategic implications that are involved.

Strategic Planning Issues and Challenges

The end product of the above analysis is the identification of strategic issues and challenges to guide the planning process. Normally, a company or major division of a company identifies six-eight major issues and challenges which it provides to sectors and to SBUs which are to be addressed in their planning process. These issues and challenges are developed from a larger list of candidates which are culled out by management meetings. The issues selected are broadly stated and usually broadly applied or applicable to the organization as a whole, such as cost containment, energy reduction, inflation recovery, or improved productivity.

Specific planning issues and challenges pertaining to individual SBUs apply only to the planning within that organization. This would include the particular opportunities and threats associated with specific DOD mission areas, competitors, and technologies applicable to the SBU.

Objectives Development

The objectives which are formed from responses to the strategic issues and challenges and to the identified opportunities and threats with critical and strategic impacts, serve as determinants of strategies. Objectives include market opportunities or programs, resource commitments toward new technologies, and objectives to further organizational strengths and deal with limitations.

Objectives are not just program/technology oriented. They may be capability oriented. Two examples might be:

- (1) Capitalize on customer perceptions of quality leadership
- (2) Develop production offsets to enter new markets.

Objective one focuses on maximizing a strength, while objective two looks at solving a problem or threat. Organizational aspirations also influence objectives. Aspirations such as the following might provide magnitude and specific attainment directions to objectives:

- Outperform the Dow Jones Industrial Average in earnings growth
- Provide a working environment which rewards individual contributions

Such objectives come from functional challenges within the organization, such as financial and human resource management.

Thus, objectives come from the environmental elements and from internal resources and functional interpretations and challenges. In looking at these "pressures" for objective setting, management must screen them into categories of "might do," "want to do," or "must do." This provides judgment on criticality and intended response necessary to prioritize and select from among several objective candidates.

Strategy Development

It is one thing to say something is to happen, and another to develop a plan of how to make it happen. This is where strategies come in, the action part of strategic planning. Strategy involves the adoption of planned courses of action and allocation of resources necessary to achieve objectives, or in the proposal sense at least the request for such resources.

Before courses of action and resource needs can be selected, alternative strategies must be proposed and analyzed. Alternatives for meeting the acquisition of a specific objective technology might be make it or buy it. This might be further developed into "teaming" to make it, or licensing it, or acquiring a company that has it.

The challenges and objectives themselves ask for answers in the form of "how." These might be:

- (1) How will the firm defend against major market thrusts from multinational competitors?
- (2) How will the business maintain reinvestment in strategic programs while satisfying cash generation objectives?
- (3) How will the business establish leadership in microelectronics?
- (4) What new sources of growth will compensate for the maturation of traditional served markets and programs?

A universal description of how to develop strategies is difficult. Development of strategy is, at least in some measure, an art permitting the exercise of creative skills and individual approaches. One approach commonly used is a strategy screen. For each objective a list of possible strategies is developed then culled. For example, if the objective was to grow in income, possible strategies might be:

- (1) Extend the product offering to new market segments
- (2) Penetrate the market further—sell more, such as go into multiple unit sales.
- (3) Diversification
- (4) Price increases
- (5) Cost reduction

Each of these can be screened for feasibility within the context of the environmental and internal forces which provided for the identification of the objective. If an income growth objective came about due to a signalled maturation of a market or DOD program, further penetration would probably be inadequate. Diversification may be inappropriate if a resource weakness was identified in long term financial capability.

Strategies are also examined for maximum synergy and the ability to meet more than one objective. Effective strategies are seldom singular in focus. Specific strategies may take the form of business opportunities. The analysis of these may require formal staff studies to provide the material necessary to select from opportunities and their ability to meet overall objectives. This will be developed in a later chapter.

Important issues must be identified and addressed in selecting among strategy alternatives. These issues often are derived from the areas of risk/threats, opportunities, and challenges identified in the initial phases of planning. Such issues that might be applied to strategy evaluation might be:

- (1) Liability exposure of the firm
- (2) Technological pace
- (3) Investment intensity
- (4) Cost leadership opportunity
- (5) Environmental protection exposure
- (6) Access to new technologies

Selected strategies provide the company with the ability to address these issues, some of which may be objectives, and others of which are merely considerations toward reaching objectives. The qualitative and quantitative processes used among DOD contractors in this process of strategy selection are addressed in a later chapter.

Strategies are developed through intermediate steps which are expressed in strategy statements. Such a statement might be as follows:

"The primary strategic thrust will be to generate funds for the corporation by maintaining market and cost leadership in segment A and pricing for profit in segment B. Technology and plant investment will be focused on cost reduction. A secondary thrust calls for limited investment in new product development until the potential is determined in segment C."

From strategy statements, programs and projects are developed to "flesh out" actions. How will the company maintain market and cost

leadership? This must be developed and made specific in a program of action, with the necessary resource commitments that will be required.

Resource Programs

Since many of the objectives and strategies are long-range in nature, resource programs become important stepping-stones toward them. For example, if an objective is to enter the telecommunication market, and a strategy is through technology leadership, the company must develop a resource development program for that technology leadership.

Resource programs become functional parts of strategic planning. They may focus on manufacturing resources and require the development of a manufacturing facilities investment plan. They may focus on supplier resources and require the development of a subcontractor development plan or a plan to develop a new material, such as a composite, or a skill in working with a material.

Business Development Programs

Just as resource programs are internal in nature, or pertaining to company capabilities, external programs are also action parts of strategies. Perhaps the company wishes to develop the market for a particular product or program. This would include marketing initiatives to specific customer targets to influence decisions. For an example, research by one of the authors on the Lockheed Corporation developed information on interests by Lockheed in developing Navy interest in using an expanded derivative program of the S-3 aircraft in multiple mission uses for the Navy. Various proposals have been presented to NAVAIR as part of this business development program.

Business development programs are not just with end customer agencies. They may also involve key partners in an overall system, or suppliers. They may take the form of intercompany cooperation, long-term contracts, licensing, franchising, joint ventures, or technology spin-off in other industries.

Financial Resources and Budgets

Once resource programs and business programs are formulated, the financial resources and budget necessary for their accomplishment must be developed. These are then submitted along with the proposed business strategies to higher management levels during the review cycle (discussed in a later chapter). Such resource needs may be denied, approved or modified, and the response then triggers an iterative review of alternative programs and new budget needs.

The commitment of resources and budgets to specific programs, and even to SBUs, must then reflect the higher level strategic plans. For example, a sector may also have its own objectives and strategies, and these, in turn, reflect where it chooses to commit discretionary resources among SBUs and SBU programs.

Contingency Plans

Suppose objectives are established, strategies and programs developed, and budgets approved. Then the assumptions upon which these were built change. What happens? Strategic plans must include contingency modes of operation so that changes in assumptions do not require complete revision of plans, but merely the change of course down a contingent course of action.

To develop contingency plans, managers must identify critical assumptions. These are the assumptions which, if not true or different from what is expected, would signal a changed course of action. Other assumptions would have more minor impact. When such assumptions or planning guidelines are critical, trigger points of knowledge about change are established, and if these are reached, the new course is adopted. For example, suppose the currency rate did not weaken to a specific level. Is this critical? Would it mean we choose a different objective and strategy? If so, when an amount of time has passed and the level of devaluation is not achieved, this trigger point signals a change of effort in a preselected direction, contingent upon that issue.

Summary

This chapter has served to introduce interested readers to strategic management and the historical evolution of the process of strategic planning which was found in most of the companies that were studied. The explanation represents a composite of the approaches used in several companies, and does not reflect, necessarily, the approach in any single company. It provides general areas of approach and techniques of the process of planning.

More depth in many of the areas discussed in this chapter is presented in later chapters. Readers interested in this depth are invited to read these chapters more thoroughly after consulting the annotated outlines of these chapters.

Figure 6 presents a flow diagram of strategic planning, as a system, in GE. It is useful in its integration of the concepts used in this chapter for organizational and process flow perspective. Additional factors in planning cycles and process flows are found in later chapters.

References

Most of the material in this report came from internal data and manuals provided by General Electric and other contractors.

Strategic Planning System

Figure 6

1. PLANS INTEGRATION

Responsibilities

CEO

- Corporate Priorities and Objectives:

- Mission, objectives
- Public image, policies
- Environmental assumptions

- Business and Resource development objectives
- Planning challenges

- Corporate Resource Development Strategies:

- Technology
- Human
- Financial
- Production
- Etc.

- Corporate Business Strategies:

- Business development
- Sector strategy integration
- Resource allocation
- Risk management

International Integration Plan

Sector Executive

- Environmental assumptions
- Objectives & bus. strategies
- Business and resource development
- Allocation priorities
- SBU strategy integration

International Sector Executive

- Company-wide strategies
- Integration issues
- Portfolio evaluation

SBU General Manager

- SBU business strategy
- SBU resource development
- Segmentation and integration

SBU Function Manager

- Technology
- Production
- People

Business Segment Manager

- Product/market strategies

Board Roles

CLB

- Assists CEO in Corp. and Sector Strategy/Budget reviews and development of the Corporate Plan.

COB

- Assists VC in evaluating and tracking critical issues and reviewing investment requests (appropriations, acquisitions/dispositions).

SEB

- Assists Sector Executive in SBU strategy review and integration

International Sector Strategic Plan

SBU SBU SBU

Sector Strategic Plan

SBU SBU SBU

Sector Strategic Plan

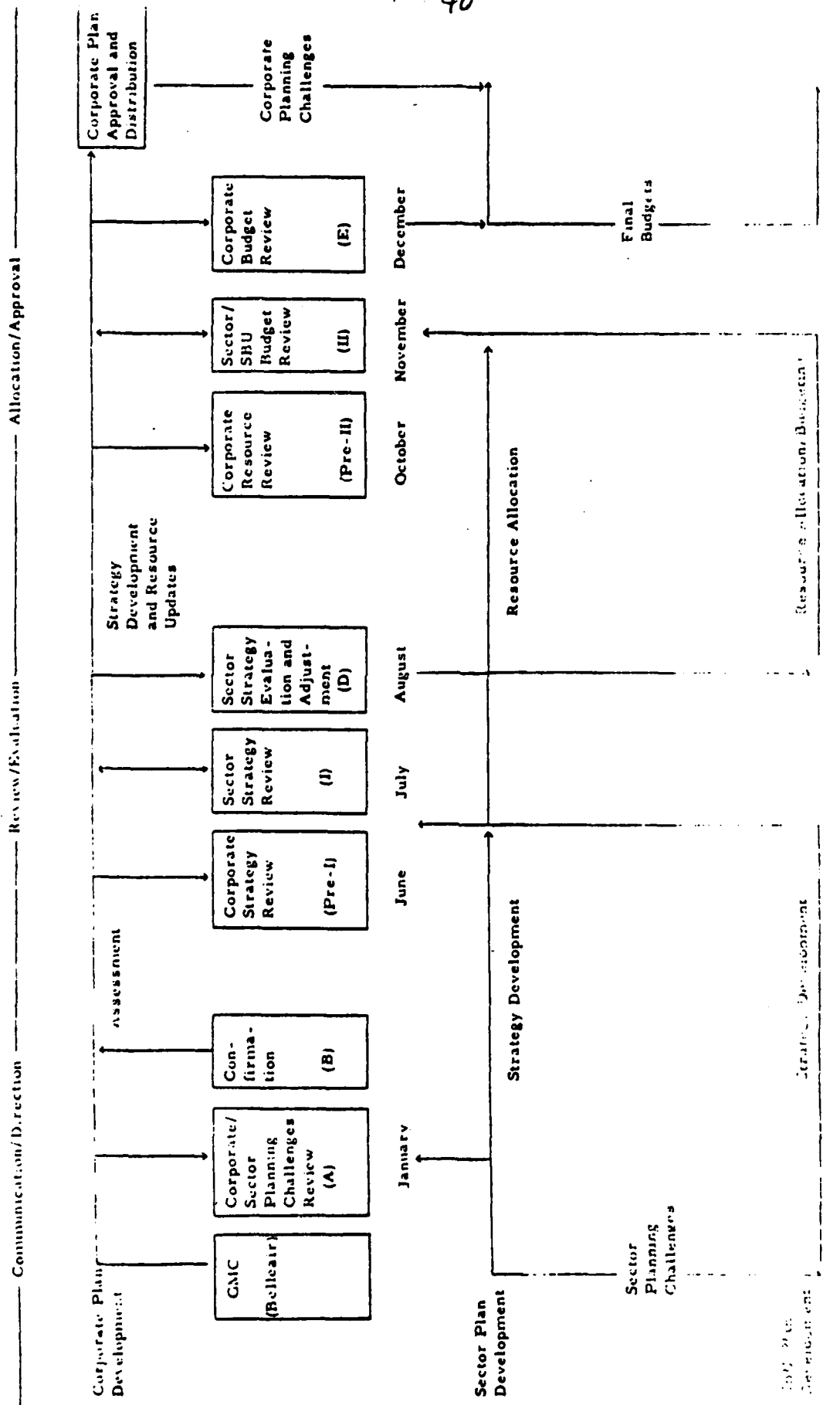
SBU SBU SBU

Local sectors

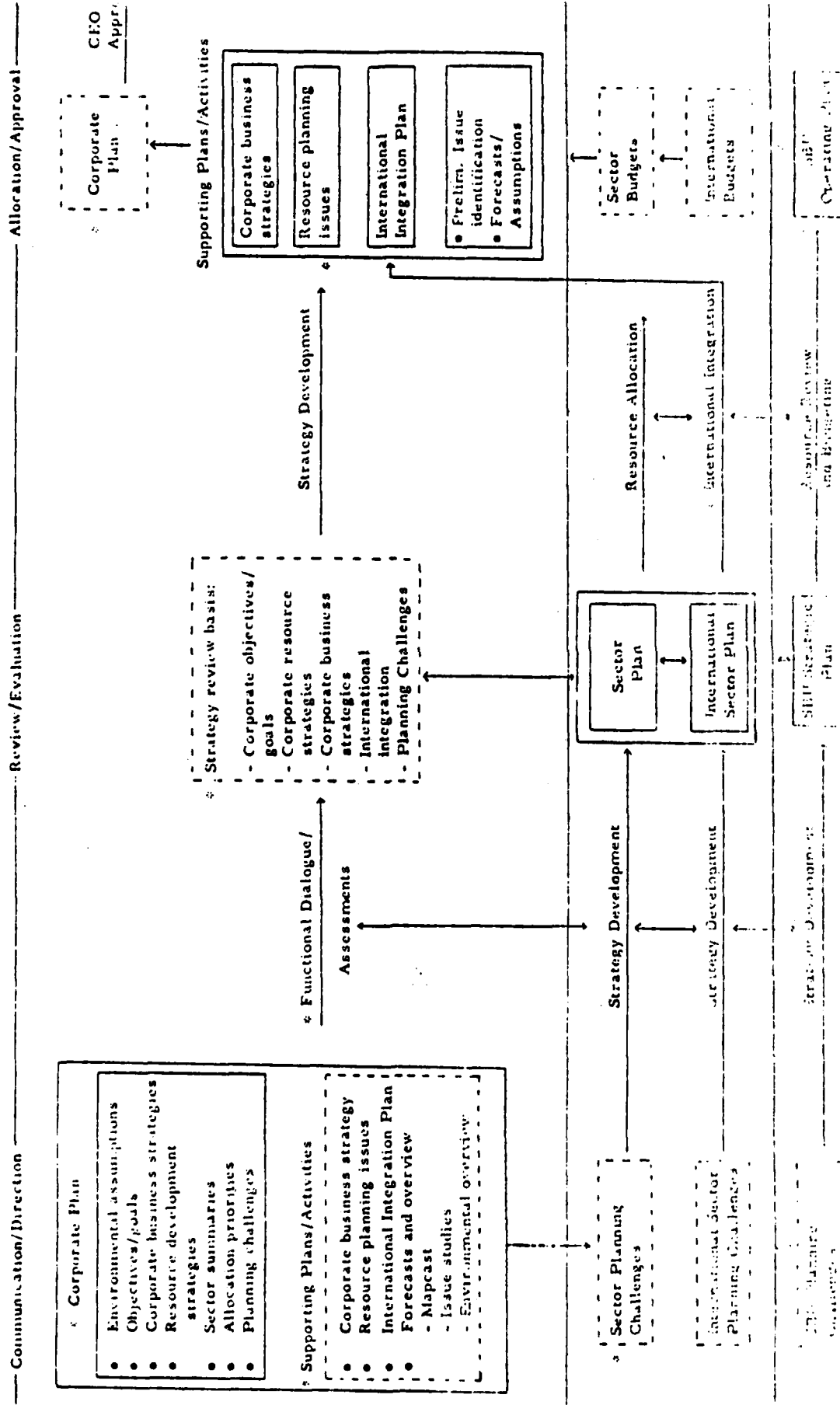
Sector with SBU integration

SBU Country affiliates

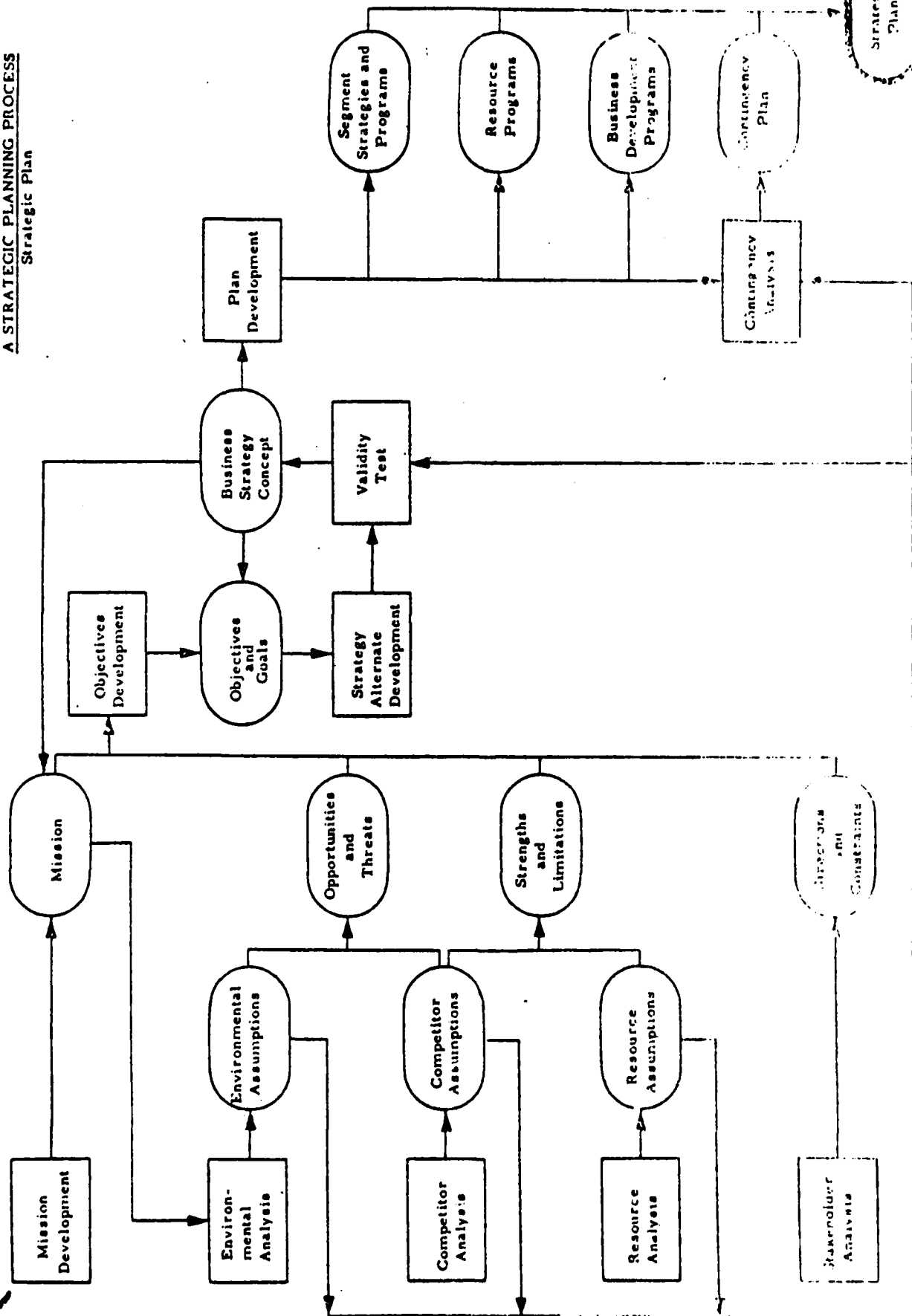
2. COMPANY PLANNING CYCLE



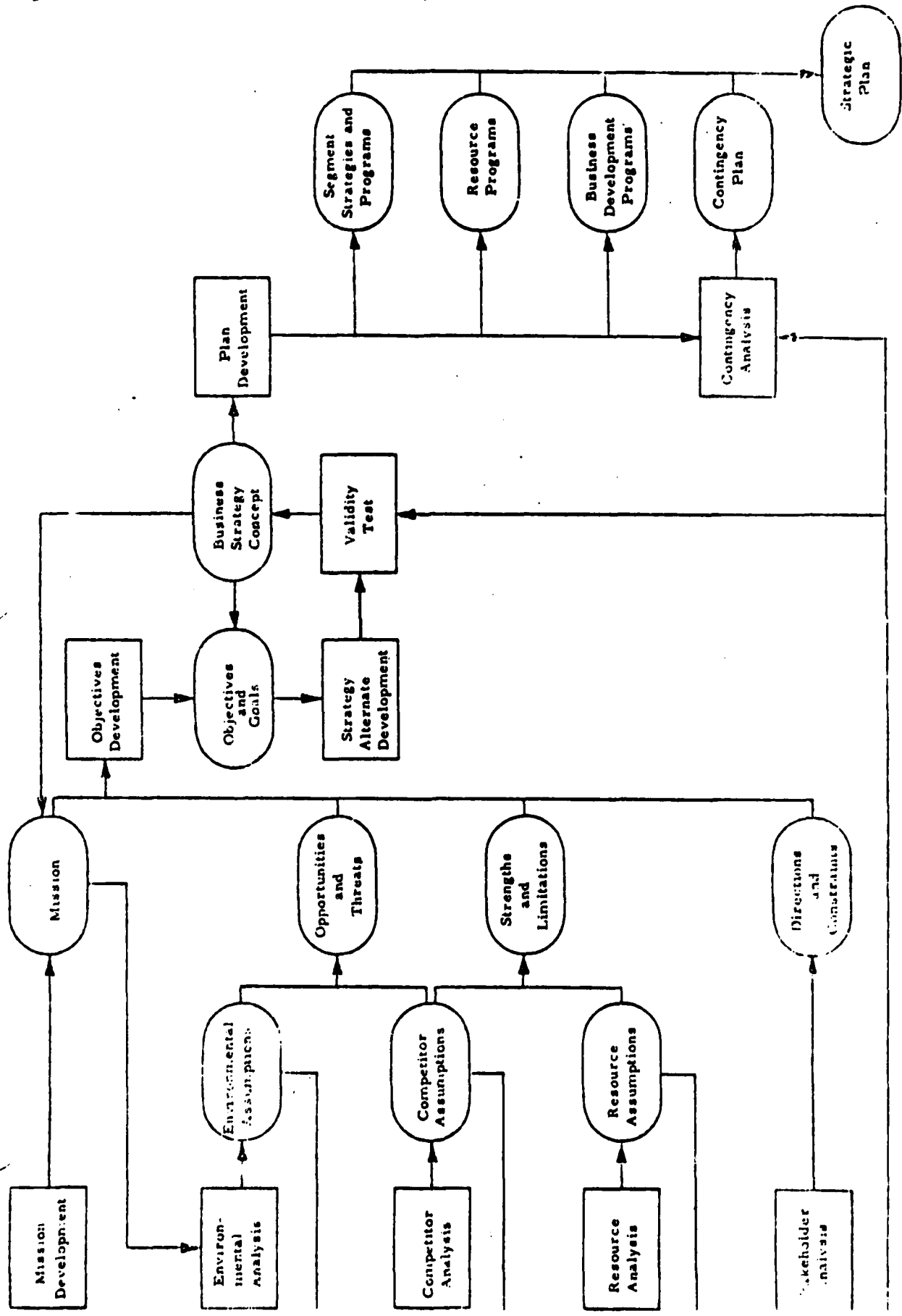
3. PLANS DEVELOPMENT



A STRATEGIC PLANNING PROCESS
Strategic Plan



A STRATEGIC PLANNING PROCESS



Chapter III

STRATEGIC MANAGEMENT PROCESSES

Having introduced an historical evolution of strategic management and the major elements of planning in strategic management, the report now turns to a more in-depth discussion of the processes of strategic planning and factors influencing the planning processes.

Planning Versus Pseudo-Planning Activities

For the sake of clarification of concepts, this section illustrates differences between strategic planning activities and trappings of strategic planning. This is difficult to some extent because there is no generally accepted model of strategic planning. Planning approaches have evolved in a variety of environments, and often managers use a different set of variables to shape the planning process.

One common mistake is confusing program/project planning with strategic planning. As discussed in the previous chapter, program and project planning is a part of strategic planning which looks at developing specific programs and projects as strategies of action to meet particular objectives which have emerged from the evaluation of environmental challenges. Steps and factors in program and project planning, such as forecasting, project flow organization and charting, and bottleneck analysis are often accepted as substitutes for strategic planning. In several instances, the interviews made by the authors found both DOD agencies and several contractors providing examples of flow charting, forecasting, and bottleneck analysis when asked to provide examples of strategic planning. These persons did not seem to recognize the differences.

An example from a DOD acquisition agency might be helpful to the reader. Planning for a particular weapons system acquisition may have strategic elements in it, in such areas of contractor motivation techniques, scheduling of deliverables and important milestones, and even identification of key concerns and problems and important courses of action. This type of planning contains elements of strategic planning, but the focus is upon a single weapons system or mission need. Strategic planning, by contrast, would focus more broadly on long-term trends

and issues shaping the supplying industry, the role of that weapons system within long range mission needs, and not merely upon the acquisition of a specific system. In business, SBU planning for a specific product line is different from examining total SBU strategies which cross product lines and markets over a long time horizon. Such planning is not limited to a single project or a single market opportunity. Such planning falls more in the realm of operational planning.

In a case series written by one of the authors examining acquisition efforts by the Navy for a Carrier On-Board Delivery aircraft system, frustrations and setbacks in program acquisition management were due to many factors. However, a key factor which came out of program acquisition management analysis was failure to provide a strategic plan based upon the broad strategic scenarios of (1) the role of the Navy in three oceans, (2) addressing the problem of extended deployment of carriers in regions without nearby shore support facilities, or even (3) U.S. policy toward defending economic interests in the Middle East. Within such a strategic backdrop, the role and mission of the COD aircraft becomes more important. Most of the strategy developed for supporting the acquisition's need for funding centered around operational type planning aimed at illustrating operational problems with current COD aircraft and deficiencies. The result was a response of "make due" with the current COD, because more pressing acquisition needs will get the budget. A deficient strategic need perspective, in the opinion of this author, was a major issue in program delays and changes.

Forecasting and charting, such as PERT, were often provided to the researchers as examples of organizational strategic planning, particularly by functional managers of procurement. Forecasting provides economic, technological, or social/political data as a basis for planning, but is not planning. Similarly organizing timing of milestones and flow of events is an ingredient of planning, but it is not planning. Bottleneck analysis includes studying the causes of a particular problem

standing in the way of goal attainment, but it is short-term in focus and normally an ad hoc activity when a bottleneck is perceived or expected. It is a tactical mode of management. Contingency planning is a strategic planning approach to preventing bottleneck analysis from occurring on an ad hoc basis.

Philosophies Toward Planning

Another important factor influencing the functioning of strategic planning is the organizational philosophy toward it. It is an issue of planning philosophy which causes some managers to confuse the types of planning described in the previous section with strategic planning. These types of planning are lacking in the essential ingredients of mission assessment, rigorous environmental scanning and challenge identification, competitive analysis, and other major external strategic issues, since they focus largely on getting a series of planned tasks accomplished.

Perhaps the most fundamental philosophical issue in strategic planning concerns where it is done and by whom. Most managements interviewed saw strategic planning as not an off-line activity, but as an integral part of how the business is managed. This makes it a task of operating, line managers rather than a staff exercise.

Management usually desires to maintain relatively dynamic position in the marketplace and to assure continued profitable growth. Planning helps accomplish these goals. However there is a growing need for more comprehensive planning in an industry subject to dynamics in technological, political and economic change. There is a need for linkage of all parts of the organization into an integrated system for the purpose of direction and resource allocation

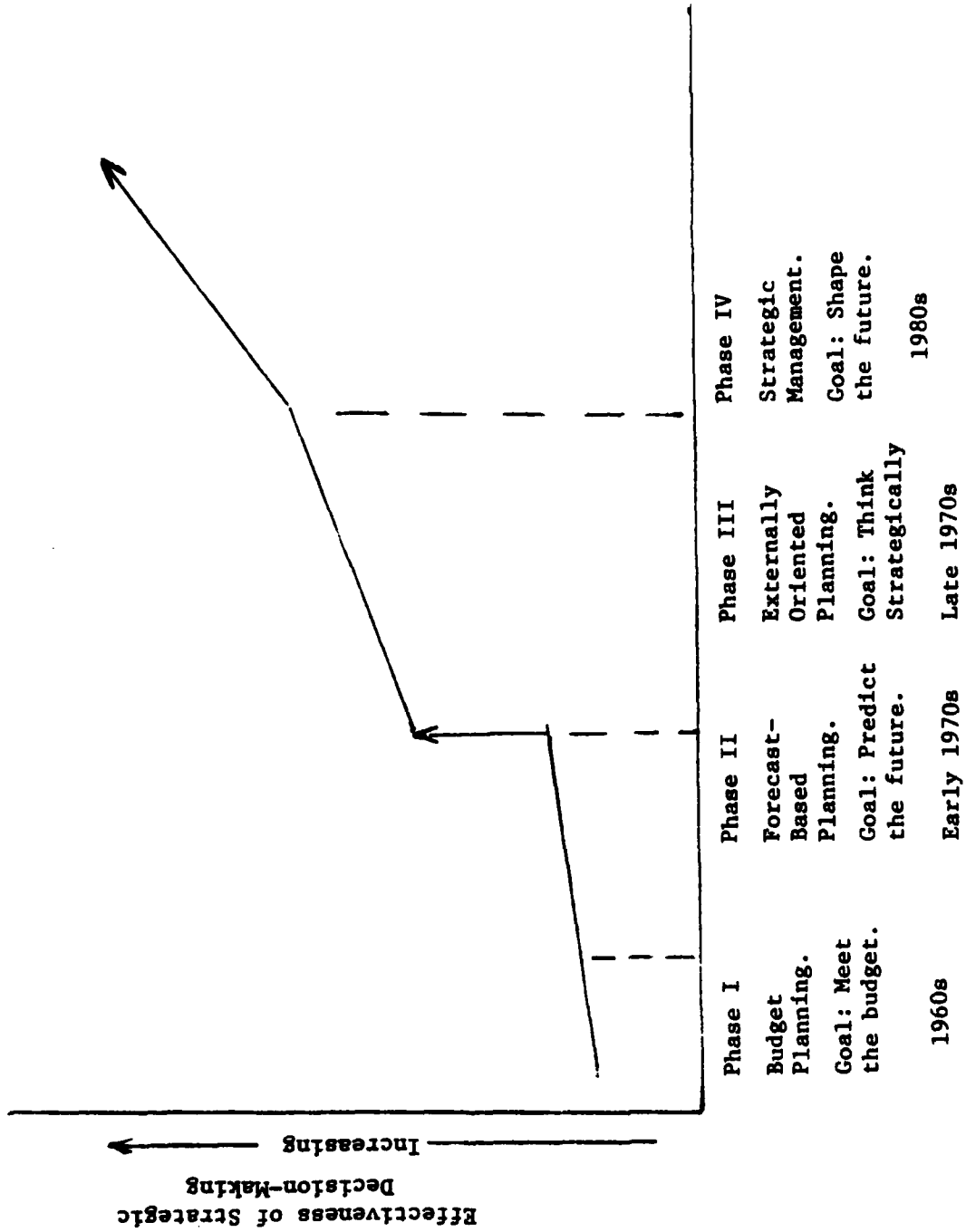
Philosophies toward planning are often reflected in corporate mission statements. One example of this comes from such a statement provided the researchers by one of the participating companies:

- (1) The company's business is primarily aerospace and its greatest expertise lies in the design, development and manufacture of military and commercial aircraft, missiles, space and related subsystems.
- (2) Because most products involve high technology, requiring substantial research, engineering and special manufacturing skills with unusually high standards of quality, the company generally is not "cost competitive" in low technology product lines and the philosophy is to avoid these lines of business.

This statement recognizes the analysis of strengths and weaknesses, direction toward a particular competency, and avoidance of markets where major limitations are involved. This strategic perspective guides the selection of opportunities and programs.

An important perspective difference on planning factors and orientation is provided in the chart in Figure 7. This traces the evolutionary phases of strategic management and their orientation toward planning philosophies. This example traces a transition in management thought and philosophy from the budget planning orientation of project/program management, with the emphasis on meeting the budget (or defending it) to the current orientation of shaping the future with entrepreneurial, proactive management. The time dimension of the model is not illustrative of where companies are, but more of when the concept in planning evolution occurred conceptually. Some companies are still in Phase I, many in Phase II, some in Phase III. Rather few are in Phase IV, according to analysis which was made by the researchers of strategic planning and management documents and systems. An even more important fact is that the percentage in the latter phases is much higher when SBU and other profit center plans are contrasted with departmental functional plans. Functional planning within areas such as engineering and procurement are much less well developed in this orientation toward the latter phases in planning philosophy.

Figure 7: The evolutionary phases of strategic management



Source: Courtesy of Rockwell International.

The transition in management approach from Phase II to Phase III occurs when the manager, whether line or functional, changes toward becoming a strategic thinker. This means not just going through forecasting and planning exercises, but thinking of the strategic significance and long-range implications of management decisions. The focus is on strategically analyzing the external environment and internal commitments.

Movement to Phase IV involves not just responding to the future, but trying to shape it and determine it. It calls for strategic decision-making which will provide what is wanted, rather than trying to make do with what is provided.

In reflecting this internal company philosophy and its impact on managerial style, one manager interviewed commented:

A manager must be measured and evaluated on both his short and long-term efforts. When he leaves to take another position, he must be evaluated on what he left behind; what he planted for others to harvest. About twice per year we take the senior management for a retreat, and strategic planning (department) is responsible to orchestrate these meetings. During the spring meeting we give direction and challenges, and in the fall meeting we evaluate the progress of the planning efforts by managers and where they have gone. It is important that the managers have their feet held to the fire. All the functional staff in planning does is to serve as a review team to try to influence the creation of plans and the thinking processes as a resource to line management. We serve to help educate them in plans and to be sure they are practical from a functional standpoint.

Styles of Management

An underlying issue in planning orientation is the style of management and the management competencies expected in an organization, both for line managers and for functional managers (such as in procurement). Two contrasting management styles could be classified as "muddling through" and "entrepreneurial management." Muddling through takes a situation at a point in time and tries to "work the problem" to get it solved. The term "work the problem" was used several times by managers interviewed in this research, referring to this style of management. The objective is to achieve an acceptable solution to

a problem which has been encountered.

Entrepreneurial management, by contrast, tries to anticipate states of nature and forecasted situations, and then take a more predetermined root effort toward preventing the problem from occurring or toward creating a future state that is desired. Such a style is anticipatory and proactive. Muddling through is reactive.

The mentality of muddling through says to DOD, "DOD is to blame for a problem because it can't make up its mind or is always stretching programs, so this causes problems that we have to accept." The entrepreneurial manager, by contrast, determines an acceptable level of risk for programs, strong probabilities for likely success and winning of contracts, and then takes the necessary action to develop resources within these risk parameters. Several such approaches are being taken by some of the contractors studied and these approaches will be reported later in this research report.

One major cause of a muddling through mentality or management style is preoccupation with near-term objectives. With such pressures on performance, an SBU manager or a materials manager may tend to compromise efforts or actions aimed at long-term payoffs. It is often difficult to evaluate and assess efforts toward strategic objectives, and with limited rewards, limited action of this type will be taken. The following comments came from the strategic planning staff in one company studied:

We haven't grown like we should because there has been too much emphasis on current profit. We are, in effect, encouraging division managers to undertake only low risk projects. Consequently, we miss out on most of the developments with long-term payoffs. I think we have forgotten that business is inherently risky, and that we have to make it possible for people at various levels in the organization to take risks.

Another problem comes from too close of attention by higher management in checking with detailed criticisms on the outcomes of planning without allowing adequate maturation time. The following ideas, comments and suggestions for improving this situation came

Manager Style	<u>Planning Activity</u>		
	Intelligence	Strategy Design	Strategy Choice
Muddler	Problems forced on the manager	Brief search, use of marginal analysis	First satisfactory alternative is chosen, no integration
Entrepreneur	Consequential opportunities are actively sought.	Opportunities compared to vision of the strategies	Opportunities chosen which satisfy long range and short range aims.
Planner Style			
Adaptive	Forecasting by predicting the environmental changes	Customers studies to find needs and preferences	Select needs and opportunities with best match and potential
	Research by studying and defining the opportunities	Alternative solutions to individual problems	
Integrative	Capital budgeting	ROI figures for proposed projects	Highest ROI projects chosen or other strategic measure
	Integrated environmental analysis	Problems and opportunities identified by studying the organizational strengths and weaknesses, environmental trends.	Alternatives viewed in an integrated fashion.

Figure 8: Structure of planning and managerial styles.

from a manager in a DOD contractor organization:

If people are going to check up on you, project by project, then it is easy to get into a pattern of looking more favorably at those projects which are more likely to come about. One way we get around this is through our own new project funds. Nobody at the top level knows about it, or they wouldn't like it. That may be one of the dangers in a company as diversified as we are. We end up making things very formal and try to over-control.

Figure 8 illustrates various managerial styles and the results in planning. Three types of planning activity are noted: intelligence gathering, designing strategy options, and choosing strategies. Under each state of planning, the muddler takes a different approach than the entrepreneur. Another way of looking at this phenomenon is the adaptive versus the integrative style of planning. The contrast of actions and results are also shown in Figure 8.

Figure 9 illustrates a continuum of management culture in an organization with respect to initiative versus passive efforts and the relative propensity to take initiatives. Passive, risk-sensitive cultures encourage stability and reactive modes. Problems are solved by ad hoc groups working on problems. Few managers are anticipatory, exploring, creative, or proactive. Strategic planning occurs in the Phase III mode.

Passive
Approaches

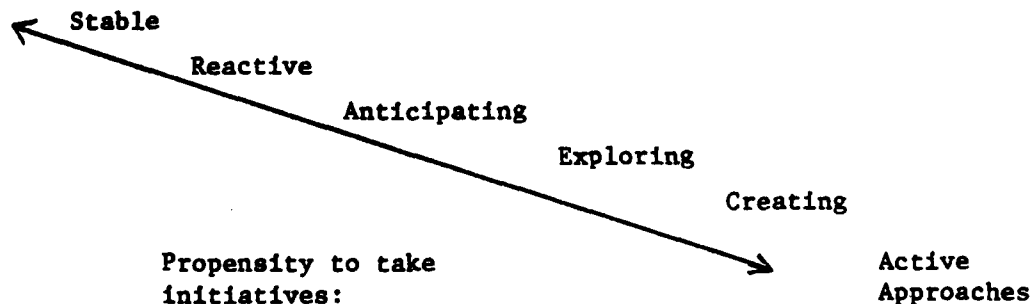


Figure 9: Planning management culture spectrum.

Managerial Styles

Managerial Behavior Attributes:	Stable	Reactive	Anticipating	Exploring	Creative
Problem solving	Problem-- triggered by trial and error.	Problem-- triggered by diagnostic skills	Anticipatory problem triggering, well structured	Anticipatory problem triggering, ill structured	Creative, ill structured
Process	Follows structure, satisfying	Satisficing	Optimizing	Follows problem logic	Creative
Leadership attributes	Custodial	Disciplinary	Growth-oriented	Charismatic, entrepreneurial	Charismatic
Management information	Past precedents	Past performance	Future based on past trends	Future departures and discontinuities	Possible new futures, invention.
Environmental surveillance	None	None	Extrapolative forecasting	Trend analysis	Heuristics
Environmental surveillance use of	Policy and procedure manuals	Control by budgeting, and MBO	Long range planning	What if modeling	Synectics, innovative behavior
Management system and					
Management science					

Figure 10: Profiles of management styles and competence in behavior skills.

Much of the management culture comes not from personal skills or competencies, but from the orientation of the goals of a functional unit. For example, the procurement function has traditionally been housed, organizationally, under the manufacturing function. With this type of structure, the principal expectation is to "keep the assembly line running and make sure you get a good price." This tactical, operational focus stems from the role of operational support to manufacturing. Persons in this job are more non-creative and non-initiative-taking in approach. During the predominance of a "buyers's market," this approach may be adequate.

The proactive culture encourages and demands managers who explore alternatives and develop opportunities beyond the short-range time frame. The reactive manager adapts to trends, but doesn't try to make them. Where insufficient efforts are being made, say, by suppliers, a proactive manager develops initiatives to change this situation.

Figure 10 illustrates profiles of general management competence and their managerial style across various behavioral attributes. From problem solving approach to management science applications, the stable manager differs in degrees and approaches from the creative manager.

Summary

This chapter has discussed the differences between planning as focused on in this report and "pseudo-planning" which has the trappings of planning, but merely uses selected planning constructs and ideas, rather than comprehensive and in-depth strategic planning. It has also examined various philosophies toward planning and how they influence planning activities. Planning is also changed by the styles of management being used, in particular reactive versus proactive management.

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Chapter IV

CHARACTERISTICS OF STRATEGIC PLANNING SYSTEMS

Chapter II provided an introduction to strategic management. Chapter III developed important differences between planning styles and management styles. The purpose of this chapter and the one that follows is to provide additional depth to the characteristics of strategic planning systems as elements of strategic management.

What are the factors influencing the operation of a strategic planning system? The first of such factors is the organizational setting and context in which strategic planning occurs. This has two parts: the relative centralization and decentralization in operations, and the role and organization of the planning department.

Organizational Settings of Planning

In this section the organizational setting is examined in two ways: the organizational setting internal to the operation, and the organizational setting in its environment. High technology organizations are more concerned with planning technology access and dependency than, say, low technology organizations. Their strategic dependency on technology influences both their internal planning and their relationships to other organizations.

Planning includes elements shaping how it is done, such as tradition, intuition and management wisdom. The entrepreneurial, development style of planning involves a high degree of autonomy with respect to goal setting and choice of actions. Within this requirement, effective goal setting and action decision-making requires both technical experts and politicians. They work closely together to balance the technical and political issues. Political aspects in strategic planning include:

- (1) The need for symbolic representations of progress
- (2) The drive for mobilization and allocation of resources

- (3) Redistribution of influence and resources
- (4) The building of consensus,
- (5) Encouragement of counter-planning and contingency planning.

Strategic planning is inherently a politically allocative process as well as a technical, scientific process, examining and assigning resource increments among competing uses.

Typically, the introduction of a planning system, particularly a strategic planning system, has an impact on the power structure of the company. If plans are to be followed, intuitive, informal relationships and "hidden agenda" become threatened. For this means, strategic planning should not be merely a means of developing reorganization. Needed organizational changes must take place before a planning system can be developed.

As mentioned earlier in this report, the responsibilities for details and commitments in planning are delegated to decentralized units, such as SBUs. The decentralization and specialized interests are both checked by the upward flow and review process.

Most companies and divisions of companies have at least some central planning staff to oversee, integrate, develop personnel, and bring the process to fruition. Typically, companies with well developed systems for strategic planning have small staffs with expertise in areas such as economic environmental assessment, technological assessment, operations research, market research, and/or finance.

Much of planning ends up in financial models and programs, since financial records and accounting reports are the means of "keeping score" in business. However, it is easy to confuse budgeting with planning, and some organizations that were interviewed provided examples of elaborate financial budgeting as substitutes for strategic plans. This is where the role of the corporate planning staff is important.

Another characteristic of the organizational setting that was discussed by several managers is that strategic planning must become

an integral part and method of management, not a special activity. In some instances, strategic plans were seen merely as conforming efforts to higher executives' wishes to go through "planning exercises."

Integration and quality control within the flows of planning elements between organizational levels are important features to improve the reality and usefulness of planning. Top-down flows involve guidance and direction toward issues, whereas bottom-up flows involve recommendations and proposals.

Strategic Planning Departments

Among the companies studied, nearly all had a formal department with a title involving strategic planning. Some other names used were market development, environmental analysis, and strategic plans and programs. Planning departments have three major areas of responsibility: (1) initiation of plans, (2) coordination of plans, and (3) detail work. Initiation responsibility involves getting the process to happen, encouraging and motivating its use and training personnel in planning techniques. Coordination involves helping the integration process in plans submission and approval, scheduling of reviews and cycle milestones, and providing for process improvements. Detail work includes such staff functions as providing data bases necessary in planning by the line and functional offices. Figure 11 shows an example by The Conference Board of major responsibilities of planning offices.

Research which the authors conducted in the aerospace industries provided some disagreement with the role shown in Figure 11. However, another responsibility was checked with the companies interviewed: namely, the responsibility for resource market planning. In all cases this was not seen as a responsibility of the planning office. In fact, in nearly all cases, managements reacted with an indication that this had never even been brought up in the company as a strategic planning line of activity. Such effort that was occurring, did so at the initiation and management of the materials office.

Responsibility of Planning Department:	Initiation	Coordination	Detail	None
<u>Activity</u>				
Economic forecasting	X		X	
Technical forecasting				X
Establishing assumptions	X		X	
Economic analysis of markets				X
Sales forecasting				X
Materials forecasting				X
Estimation of product life cycles				X
Determination of organizational goals	X		X	
Appraisal of top management attitudes	X			
Examination of company strengths and weaknesses	X		X	
Evaluation of management proposals	X	X	X	
Determination of markets in which to operate	X		X	
New technology development				X
New product development				X
Market development				X
Human resources development				X
Capital budgeting	X			X
Preparation of investment proposals		X		
Planning new facilities				X
Integration of plans		X		

Figure 11: Planning department responsibilities in a large chemical company
Source: The Conference Board.

Basically, department planners do not plan, they help others to plan. The data in Figure 12 from The Conference Board show the frequency of various responsibilities in a survey of several companies across several industries.

Responsibility:	Number of Mentions in Survey
Proposing or participation in the formulation of objectives	106
Proposing or participation in the formulation of strategies	102
Developing, revising, monitoring proper functioning of planning system	101
Serving as an idea source for CEO and other top management	100
Counselling operating management about planning problems/issues	100
Educating top and operating management about planning techniques	91
Investigating socio-economic-technical environment and formulating assumptions and making forecasts	84**
Evaluating operating management's plans for effectiveness	82
Identifying new opportunities for internal development	80
Monitoring performance against plans	75
Consolidating and editing written plans	71
Serving on management planning committee	71
Proposing or participating in formulation of unit/functional objectives/strategies	64
Developing and maintaining computer-based models of the company and industry	54
Sales or market forecasting	38
Other--guidance in research, catalyst in problem solving	18

Figure 12: Survey of planning department responsibilities

** This function was noted as particularly common among aerospace companies studied in this report.

The duties of strategic planning executives are as varied as perceptions of the responsibilities of the department. The following are basic statements of duties/responsibilities from job descriptions surveyed by The Conference Board:

Provide corporate-wide policy direction, coordination, follow-up and assessment concerning long-range plans, operating plans, quarterly reviews, and special planning studies. Administer the activities of the corporate planning organization.

Preparing and updating strategic corporate development plans based upon, among other things, five-year business plans prepared by the various operating units and, under the direction of the Executive Vice President, assist in corporate acquisition activities (merger, not procurement). Conduct for the corporation market research associated with planning and development and provide economic evaluation services. Have functional supervision over and evaluate the performance of all executive offices, the international subsidiaries, and divisional and subsidiary personnel whose activities involve corporate planning, market research and economic evaluation.

Specific duties listed in job descriptions studied by The Conference Board were:

- (1) Direct activities of plan management, environment and strategic planning, diversification planning, and planning information center functions.
- (2) Develop, analyze and promulgate the major corporate and component objectives and goals, planning assumptions, policies, procedures, and other items related to the environment and the corporate planning process.
- (3) Provide intelligence concerning customer and competitor business positions, plans and programs as required for development of long-range plans.
- (4) Direct the development, coordination, analysis and follow-up of long-range plans, operating plans, quarterly reviews, and special planning studies.
- (5) Assess individual component plans with corporate new product, merger, acquisition, and diversification plans, and consolidate these elements into a long-term strategic plan for the corporation.

- (6) Assess overall corporate long-range plans and operating plans and make appropriate recommendations to corporate management.
- (7) Provide capability for preparation of sales and market forecasts and develop business plans for new products not feasible for development within components.
- (8) Cooperate with fiscal management in tracking operating and financial performance related to approved operating plans.
- (9) Direct the annual strategic review to ensure the fundamental corporate orientation is consistent with the basic objectives and goals.
- (10) Maintain current information with respect to industry-wide planning concepts and techniques and recommend changes in the company's integrated planning and review process when appropriate*.
- (11) Direct operations of the planning information center to support and display presentations related to overall company operations and long-range plans, operating plans and quarterly reviews.
- (12) Issue annual management events calendar after corporate division and component coordination.

Planning departments are staffed in various ways, usually involving several planners as well as staff specialists in areas such as market analysis, market research/forecasting/forward planning, and economists. Another company's strategic planning office had these responsibilities:

- (1) Develop, based upon appropriate inputs from operating divisions and corporate staffs, well-integrated strategic corporate plan, with annual updates. Must provide clear objectives and guidelines to all segments of the corporation, within which shorter-range operating plans are defined.
- (2) Recommend programs, policies, and business areas that will

*This responsibility has particular applicability to the resource market issues, but this responsibility seemed not to be recognized in the companies studied or even in the report of The Conference Board.

provide for the sound growth and profitability of the corporation.

- (3) Coordinate and administer assignments related to various strategies, short- and long-range plans, programs and activities of the corporation in concert with approved corporate objectives.
- (4) Participate as a member of the research guidance boards of the corporation's groups and research and development.
- (5) Provide functional supervision of corporate planning activities to divisions, subsidiaries and the international subsidiary.
- (6) Provide professional advice and counsel to corporation divisions and subsidiaries in the preparation of long- and short-range business plans.

This particular job statement also addressed responsibilities of the corporate planning executive in specific areas of market research, economic analysis, acquisitions, financial coordination, and special studies. Of particular importance are responsibilities, technically, in the development and review of critical economic assumptions used in economic evaluations in order to provide consistencies in planning, and also to provide criteria which are objective to be used in reviewing plans. These latter areas were provided by a management team in a large aerospace company studied by The Conference Board. There was no indication, however, of resource market issues in any of the above tasks.

With this presentation of the responsibilities and duties, the reader is cautioned to understand that statements concerning "corporate" planning personnel apply equally well to divisional planning departments. Conglomerate corporations often function quite autonomously in strategic planning, with merely overall strategic issues promulgated from the top. Consequently, where the above examples refer to divisional and subsidiary levels, they could be interpreted to refer to specific areas such as aerospace divisions. This is of particular importance when planning is examined within the context of both commercial and military/government program divisions.

Figure 13 was taken from a functional description of strategic market planning at one of the DOD contractors studied. Basically,

Strategic Market Planning

Primary Function:

Conduct strategic analyses and market planning as required by the director—program development and marketing and as may be directed by the VP General Manager.

Duties:

- Direct the analysis of total market environment, i.e., stated needs and requirements, priorities, trends, fund availability, potential market, competition, positive and negative forces.
 - Gather financial requirements including new business funds (IRAD, B&P) and capital expenditures and estimate financial performance for candidate opportunities.
 - Direct the new business funds and capital expenditure coordination related to new business acquisition.
 - Assist in preparation of long range planning strategy in coordination with ongoing new business fund activities.
- Maintain business and investment forecasts for periodic reviews with headquarters.

Figure 13: Functions and duties of strategic market planning office

the function is responsible for market opportunity assessments and financial planning. The document supporting this information also noted that the planning tasks include a reexamination of business goals concerning the changes in market environment and company posture and development/definition of a flexible business strategy pertaining to:

- (1) Near term and long term projects and strategies
- (2) Traditional versus new products
- (3) Product development goals
- (4) Market development goals
- (5) Resource allocations

These tasks occur within the following overall business goals for this company:

- (1) Near term protection of the work force
- (2) Long term real growth
- (3) Moderate diversity of products
- (4) Moderate diversity of markets
- (5) Emphasis on prime contractor roles
- (6) Emphasis on high technology products

Figure 14 represents the company's impact period new business resources planning form. This form examines product lines and items within the lines for near term, 1980s and beyond for long term applicability as well as major new product ideas stemming from forecasted DOD needs.

Impact Period New Business Resources			
Product/Programs:	Near Term Impact	Mid 1980s Impact	Late 1980s and Beyond Impact
Product Line A			
Item 1	X	X	X
Item 2		X	X
Item 3			X
Product Line B			
Item 1	X	X	
Item 2		X	X
Item 3	X		
Product Line C			
Item 1		X	X
Item 2		?	X
New Products			
Item 1		X	X
Item 2			X
Item 3	X	X	

Figure 14: Time-phased product impact scheduling and planning

Figure 14 illustrates that in line A, the company has a product/program which will run in near term and through mid-1980s, one which will come into producing a financial impact in the mid 1980s and will continue beyond, and one which will not develop impact until the end of the 1980s, but which is currently committed and being developed.

In line B, the company has a similar situation, except item 3 has only a near term focus and the program is expected to terminate before the mid 1980s. Line C has a product coming in later and extending past the 1980s and one where the mid 1980 impact is uncertain, but it will have an impact in later times. New products being planned call for impact in mid-late 1980s, and one potential new product for this company will have current impact, perhaps proposing to be a second source on a current program--a product new to the company.

This company appraised new business with what it termed an opportunity index. This technique and others will be discussed in the next section.

Another planning department provided a listing of what it thought were its corporate planning philosophy issues. These were:

- (1) Use a plan as a direct management tool
- (2) Build all plans from the bottom up
- (3) Use line department participation to obtain plan data credibility
- (4) Integrated plans are a basis for annual controls of budgets
- (5) Accept large amounts of detail, but summarize for management
- (6) Conscience tracking--use operating plan and prior forecast for establishing reasons for deviations

Figure 15 shows the organization of one of the planning departments. This represents a fairly typical organization for the departments that were studied, although this example is somewhat more elaborate than usual. The function was for the vice president of plans at a corporate division.

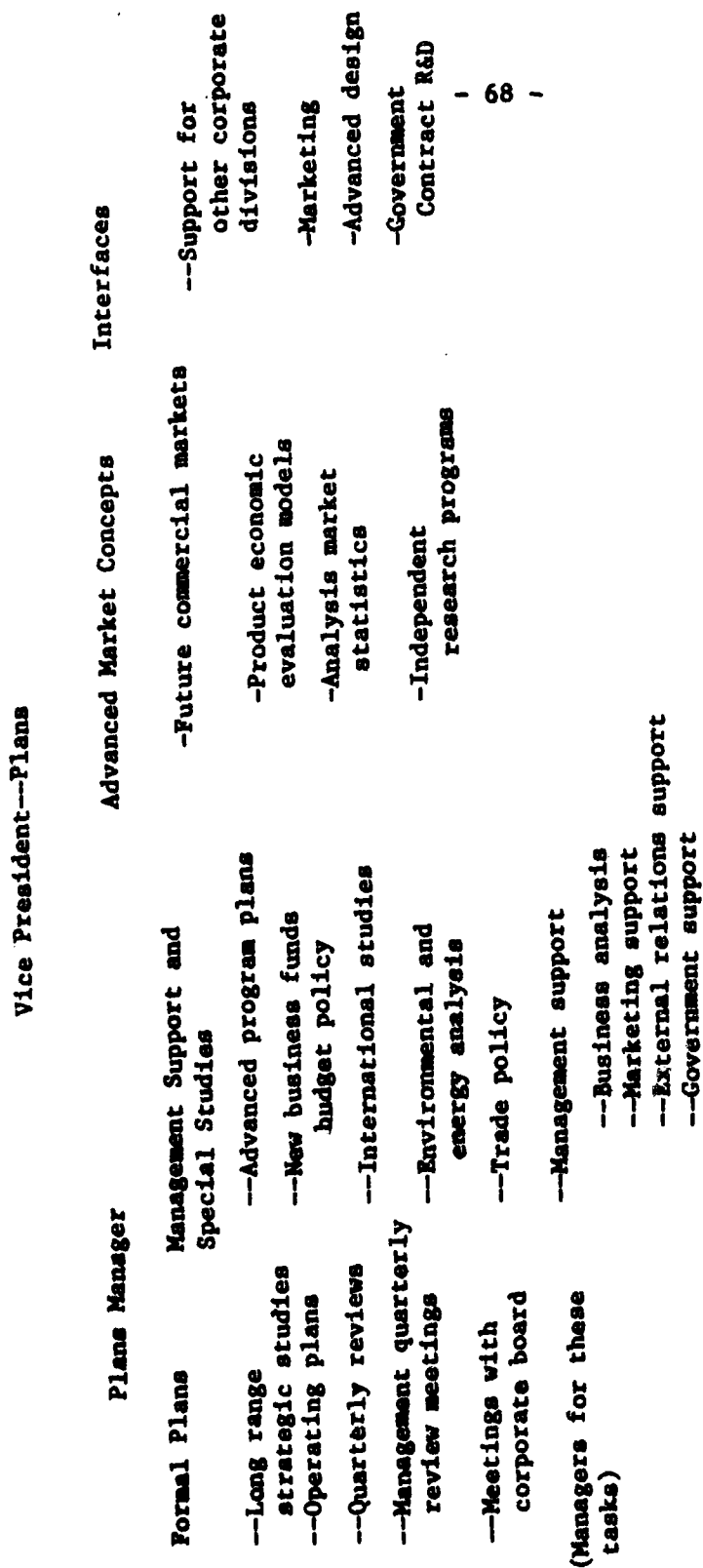


Figure 15: Organization chart for vice president of plans.

Additional information on organization of planning and planning operations can be gained from Appendix D.

Business Analysis and Planning

The purpose of this section is to present various examples of constructs used in new business planning in the aerospace industry. One company indicated that it classified new business into three categories: targeted new business, planned new business, and new business. Targeted new business consists of those projects which customers may decide to develop and fund, but which require a large amount of market development effort in this direction. Planned new business are potential sales where the customer is making active effort to get the program on contract, but a supplier has not yet been selected. These projects are in the proposal and bidding stages. New business consists of new programs for the company wherein contracts have been awarded. A senior manager commented as follows on this succession of statuses:

Planned and targeted new business consists of opportunities where we think we have a reasonable chance of winning. Management wants to pursue it and is willing to put money behind it. There is increased risk that the money will have a payoff as a program is further down the line from planned to targeted. If something is deemed "targeted new business," we would, say, be willing to spend the promotion money to convince, say, Australia that if we move it up to planned new business, we are willing to make an option to commit long lead forgings.

We look at these business status flows over five years. Targeted new business is defined as having a potential for a major dollar impact within three years, but wherein some market development work is needed. When we think we have a reasonable chance of moving business to a higher category, we will turn on engineers to put money into technologies behind it and we go for business funds requirements.

Demand assessment was an important part of new business planning, and companies have various ways of doing this. One company used what it termed a new business opportunity index wherein it assigned numbers from 1 to 5 according to the following issues and ranked programs according to the numbers received:

- (1) Program viability and survivability of the DOD/Congress gauntlet
- (2) Competitive posture going for the program
- (3) Ratio of new business funds to the sales at stake
- (4) Exposure to termination liability as a ratio of cash flow
- (5) Product development risk (technical)
- (6) Market development risk
- (7) Value added in-house

Another company classified program opportunities by name, product type, customer and end user and classified them also according to whether they were production, development, or technology oriented. Issues used in evaluating programs included: contribution to growth goal, contribution to profit goal, provision of needed technology, source of a critical technology, provision of entry into a new high growth market. These issues were weighed in selecting whether or not the program would be pursued. Figure 16 illustrates a market forecasting sheet used by one company to determine market plans.

In Figure 16, the total market represents, say, expenditures of the Federal Government on computer-based systems. The market of interest could be, say, command and control. The portion committed to others represents business under actual or highly probable commitment to a competitor with little probability of award to another supplier. The market of interest less the committed business provides the estimate of the available market. That committed to the company doing the forecast, under the same criteria as that committed to others, indicated the remaining revenue "up for grabs," as one manager put it. The company also indicated the ratio of its committed business to the total revenue to determine market share relationship. Quantitative numbers for this sheet come from program forecasts and expected dollar expenditures that will be approved through funding cycles.

The company also noted what it terms "key programs," those it considers necessary to success in the long run in its business area. These are listed by program name together with a report as shown in an example in Figure 17.

		Market Forecast (\$ in Millions)									
<u>Factors</u>	<u>ACTUAL</u>	<u>Current Year</u> <u>Plan</u>		<u>10 Year Projections</u>							
Date:	1977 1978 1979 1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990

Total market

Market of
Interest

Committed to
others

Available
market

Committed to
our company

Revenue

Market share%

Figure 16: Market assessment sheet for planning horizon through 1990

Key Programs					
<u>Program Title</u>	<u>Entry Date</u>	<u>Current Status</u>	<u>Gross Value</u>	<u>Remaining Value</u>	<u>End of Program</u>
Program X	1974	Development	\$400m	\$350m	1987
Program Y	1976	Production	\$200m	\$100m	1984
Program Z	1979	TTF&T	\$3000m	\$2900m	1989+

Figure 17: Key program analysis for remaining potential and business type category.

Figure 18 illustrates the use of business area plan financial data used in evaluating DOD programs in strategic plans. Financial indicators show the economic value of the program, discretionary investments show the costs of commitment, and pro forma indicators show the company impact of success in these programs. Pro forma ROA is pro forma operating profit percent multiplied by the asset turnover. Pro forma ROI is annual pro forma net income divided by average annual investments. Orders represent the actual or projected value of opportunities for which a bid is expected to be submitted. Revenue is the actual revenue incurred consistent with company sales recognition practices.

Bookings analysis was another planning technique described to the researchers. The key issue here is management of the business mix across various product lines, such as hardware design, product enhancement contracts, software applications, software support, and other such lines in a computer company. Programs of DOD are analyzed for their content of these various product lines and the needed balance the company desires. Analysis points up a current problem situation and planned actions. Planned actions are then budgeted for in a form similar to that shown in Figure 19.

Business Area Plan Financial Data

Date of Submission:	ACTUALS	Current Year Plan	10 Year Projections
	1977 1978 1979	1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990	
Financial Indicators			
Orders \$			
Revenue \$			
Operating Profit \$			
Operating Profit % Revenue			
Asset turnover			
ROA %			
ROI %			
Discretionary Investments			
IR&D \$			
B&P \$			
Profit Investment \$			
Service Eng. \$			
Demonstration Costs \$			
Incremental Capital \$			
Divisional Support Capital \$			
Pro Forma Indicators			
Operating Profit \$			
Operating Profit %			
ROA %			
ROI %			

Figure 18: Business area plan financial data sheet

	FY 1981	FY 82	FY 83	FY 84	FY 85	FY 86
Resource Requirements:	Required	Allocated	Budgeted			
B&P Money in \$k						
Systems Study in \$k						
IR&D Product Dev. in \$k						
Company Sponsored in \$k						
Technology Dev. in \$k						
Capital Equipment in \$k						
Total						
Program Potential:						
Bookings:						
Probabilities:						
Program go with Govt:						
Company win Contract:						

Figure 19 : Resource commitment and bookings potential analysis sheet

Programs selected for major resource commitments also received detailed analysis on a business opportunity planning document. This calls for a statement and analysis of the program's significance to the company, timing of contracts and amounts, a discussion of competition and competitive strategies, and a statement of the overall marketing strategy of the company in going after the contracts. Programs are judged for this commitment through the use of factor weightings for program content by product class. This is shown below:

<u>Program Content</u>	<u>Factor weightings</u>
Computer hardware	1-2*
Computer enhancements	
Secure data links	
Sensor display	
Communications switches	
Other hardware	
Software	
Software tools	
Comm. Systems management	
Services	

*Each content element is given a selected weighting from 1 to 2 in this company to three decimals, such as 1.225 or 1.050. Programs are also judged by the program system classification they fall under, such as:

<u>Program System</u>	<u>Factors</u>
Command and Control	1-2
Communications	
ATC	
Intelligence	
Navigation/Guidance	
Weapons Control	
T&S	

These factors are then placed for each potential contract into algorithms developed by the company, termed "Market/Program opportunity

selection algorithms. The empirical formulas used were developed with the purpose of prioritizing business areas identified as potential business for the company. It is not used as a substitute for management decisions, but as an area of information. Because of a request from the company, an example of the algorithms used is not presented in this report.

The company also used what it terms as "opportunity definitions." Opportunities are situations in the pursued or market of interest which are qualified and unqualified. Qualified opportunities are programs which are fully documented to provide program budgets, milestones, and sales objectives, while unqualified ones are not and have minimal resource investments.

A slightly different program planning document for business classifications and program listings is shown in Figure 20. This lists three classifications, whether it is under contract or under pursuit, and the division of the company involved.

Division:	Under Contract		Pursuing	
	Production	Development Technology	Production	Development Technology
A				
B				
C				
D				

Names of programs and dollar amounts.

Figure 20 : Divisional orientation to contract classifications.

Analytical Constructs

Several companies have developed analytical constructs used in strategic planning. Two from GE were presented in an earlier chapter. This section presents others found in the research. One such construct is termed SWOPT analysis, for: Strengths, Weaknesses, Opportunities, Problems, and Threats faced by the company. This is basically used in analysis of competitive positions. The division or company assesses its strengths and weaknesses, it then identifies opportunities and problems it faces competitively, then it identifies threats which are or may be emerging in the environment. This forms a basis for identifying strategic issues in competitive strategies. An example of this is shown in Figure 21.

Further refinement of SWOPT analysis includes the assessment of a probability of occurrence for problems and threats, an assessment of the revenue or profit impact possible, and an indication of possible capital commitments needed to deal with the problem or threat. Strengths and weaknesses are also addressed and ranked in areas of functional skills, such as R&D level, R&D direction, supply relations, finances, and others. Then these are assessed in four categories of competitive classification: Unique, Among the Best, About Average, and Average or Below.

Customer Dialogue in Planning

Customer dialogue, particularly that with DOD agencies and other executive branch organizations and with Congress, are a key part of the planning process of companies. Although this dialogue takes on several forms from merely attending hearings to reading published reports to iterative interchanges it is a key part of the market orientation and demand assessment process.

One large aerospace firm noted that it received from the Air Force long range planning documents relating to R&D projects. From these documents management targeted contracts to support that R&D effort, but

SWOPT Analysis of Competitive Position

Division Facts:
STRENGTHS:

A (such as rapidly growing)
B (Ranked third in industry)
C

Opportunities:
Greater profit and revenue opportunities.
etc.

WEAKNESSES

A (such as cash flow to finance growth)
B (Distribution network)

Problems:
Large working capital requirements

Threats:
Emerging technology in competitor's organization

Major weaknesses, opportunities, problems, and threats, plus areas of maximizing strengths are then addressed in the divisional strategic plan and become challenges for SBUs.

Figure 21: SWOPT Analysis in Competitive Position

decisions were made to follow contracts with corporate R&D money even though no long-range planning documents were provided. The manager noted the following symbiotic relationship with the Air Force:

Several years ago, we saw a need for increased sophistication of air defense systems. Since we are in a business that supports that, we looked at air defense systems using our kind of product and the effectiveness of those systems. We then developed a computer simulation to compare the effectiveness of proposed solutions to problems against other approaches for incoming aircraft (ala A-109). We also used this simulation to determine the survivability of our system under a European theater scenario of terrain. We visited with the Tactical Air Command and showed them the technique with a deep interdiction mission. We said to them that they were to select the aircraft to be simulated and give us the data. We would do the survivability analysis using our simulation. We wanted to know, in particular, the avionics role in the survivability analysis. We provided them with reports of our findings in exchange for their data. We did the computer simulation and analysis out of our own overhead funds.

From such studies of military situations and from military long range planning documents, this company prepared its IR&D proposals in terms of forecasted dollar expenditures that it expects over time and this is then matched with management's view of the business needs.

In addressing his perception of the relative risk in dialogue and demand analysis for military systems versus commercial aircraft support systems, one manager commented:

Regarding the relative risk of military versus commercial business, this company, whose business is largely military, feels that the commercial business is really the world of risk. In that market, all the R&D costs are borne by the company when they occur and they are only recovered in the sale of a piece of equipment. Up front R&D funding is done at the company's own expense, and that means a lot of termination exposure. The main stages of risk are in the design and development stage, prior to full scale development.

This manager indicated that in his opinion, on the military side, the risk was sheltered more by the ability to know the advance requirements of the service and to have a fairly good feeling for the probability of funding and of winning a program. However, he did note that such

a position was largely a function of the quality and the credibility of the information which his company was given and which it acquired. He noted further:

The real attendant risk comes from the inability of the government to make up its mind. Although in commercial sales, if you do a good job there is a reasonable expectation of a year to year continuity, that is not the case in the military. In the commercial marketplace the selling is a dominant fact and can try to drive the market--you are in more control of your own destiny. In the military market it is the design that drives the market and there is no assurance of continuity in production. We have more weighing of contingency factors in the military side of the house. More "what if's," like, what if this program died?

Many of the contractors' total business in the military market is dependent on as little as 1-2 or perhaps ten major programs, both current and future ones. One manager commented:

You work out a contingency plan in the event a contract is lost or a program changes, and this plan is also our alternative to be used along side of our "best guess" plan. Product planning must go on at our risk in order to have a business way ahead of DOD decisions. In some cases before DOD expresses a need. For example, in the high electromagnetic field we have developed a system for secure communications, even though we have received no formal requirement from DOD. It took us 4-5 years to develop it.

For a more detailed set of material on business environmental assessment and other aspects of environmental analysis and customer dialogue, the reader is referred to Appendix A in this study. Appendix B goes one step further and illustrates an in-depth example of a business opportunity situation audit in the aerospace market and the procedures used by one major company.

Operational and Functional Plans

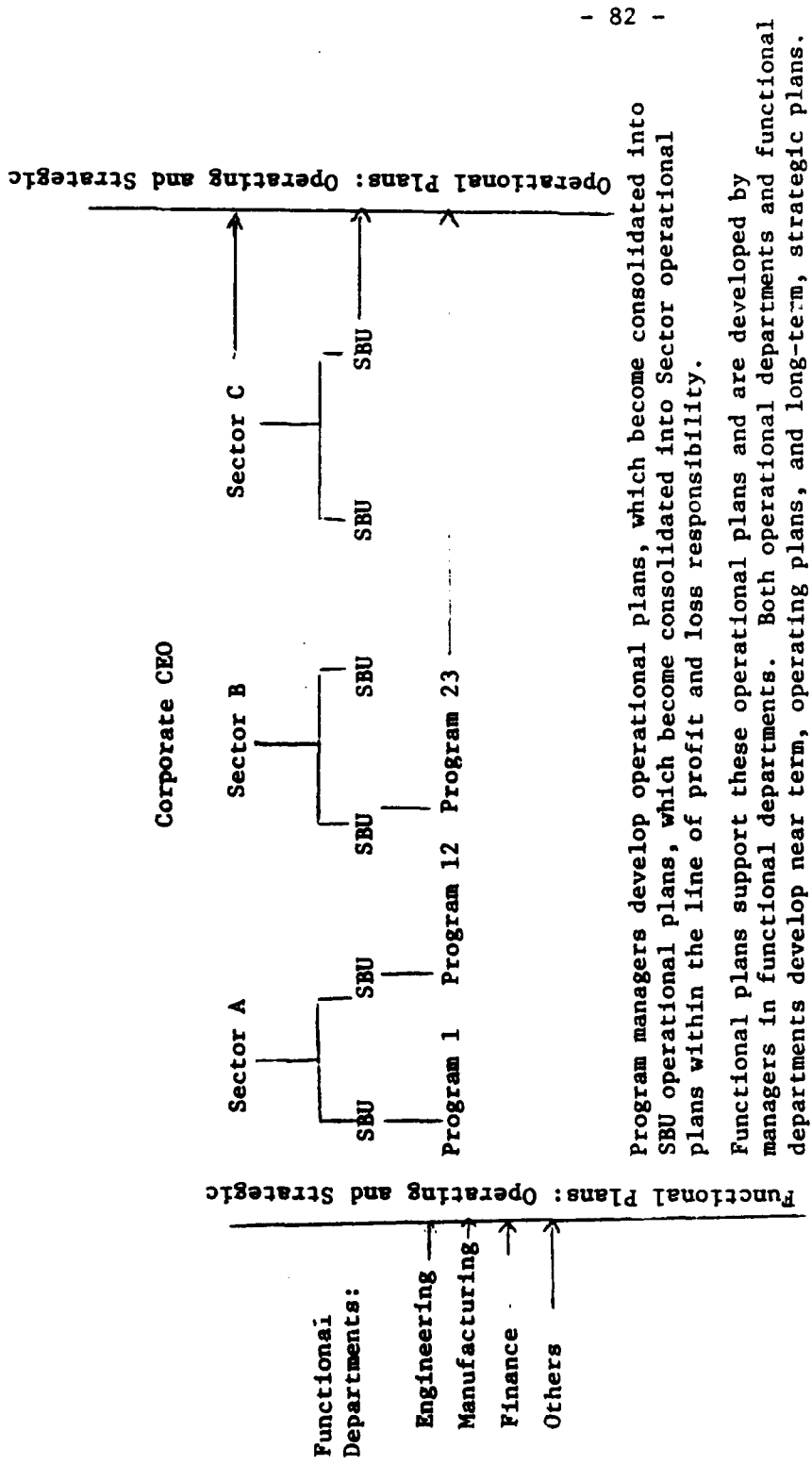
Before moving further into the planning process, the authors judge it to be important to develop more of an explanation about operational versus functional plans.

Operational Plans versus Functional Plans

The reader is cautioned to gain a clear understanding of the difference between "operational plans" and "operating plans." Operational plans are those plans developed by managers with profit and loss responsibility, such as a program or SBU manager. These line managers write operational plans to provide direction and support resource needs for their area of operational stewardship. The contrast to these plans is functional plans. Within the typical matrix organization, functional managers, such as managers over manufacturing, engineering, purchasing, develop plans for their functional area. Since they have no direct profit and loss responsibility, these plans pertain to the directions and needs of their functional areas.

Operating plans are short term plans of one-four years in duration as opposed to strategic or long-range plans. They are near term in focus and more detailed in budgeting than strategic plans. Operational planning includes both strategic, long-term plans, and operating near term plans. Functional planning includes both strategic and operating plans, although in many companies—including most of those studied—functional plans are largely operating, and not strategic. This fact is an important issue pertaining to the investigation of this report, and will be developed later in chapters dealing with the procurement function.

Figure 22 illustrates a functional planning approach—an approach used by functional support units, such as engineering, manufacturing, or finance. Operational units, such as SBUs or divisions, provide materials from their own operating and strategic plans to functional organizations. These data, such as requirements for engineering effort, cash investment, or manufacturing capacity, provide the basis on which the functional plans are built. These plans represent the horizontal aspect of the planning matrix which flows up the organizational hierarchy into sector and corporate plans.



Program managers develop operational plans, which become consolidated into SBU operational plans, which become consolidated into Sector operational plans within the line of profit and loss responsibility.

Functional plans support these operational plans and are developed by managers in functional departments. Both operational departments and functional departments develop near term, operating plans, and long-term, strategic plans.

Figure 22: Planning matrix within the operational and functional departments.

Summary

This chapter has introduced some of the characteristics of strategic planning systems, focusing on the organizational settings in which planning occurs (the reader is referred to Appendix D for additional information), the roles of planning departments, and issues in business planning and analysis. It also presented an introduction to the contrast between operational and functional plans.

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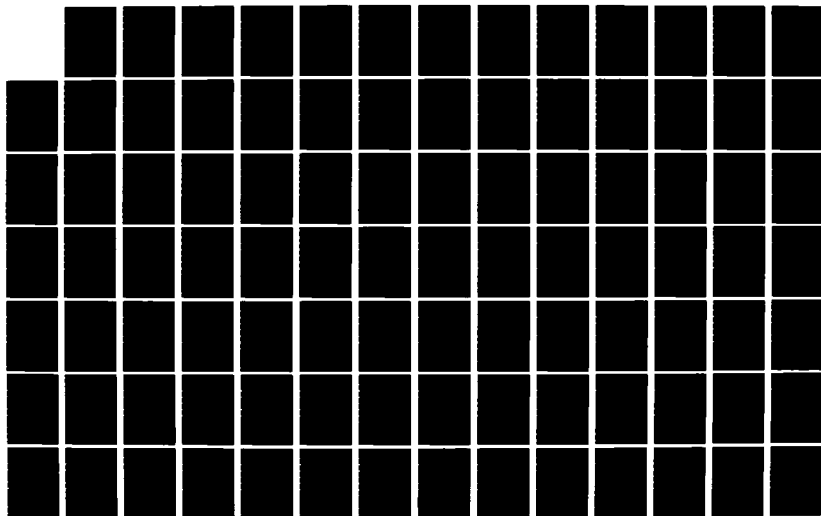
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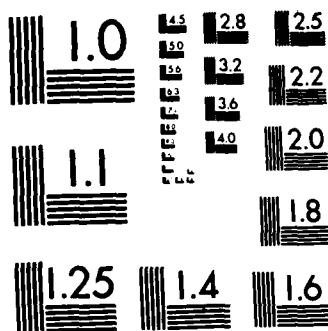
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Chapter V

STRATEGIC PLANNING FLOWS AND CYCLES

Planning involves a confrontation of the expected and the intended performance and the organizational capabilities to deliver the performance within controls which are established. Planning can be either transformation-oriented or adaptive-oriented, or perhaps a combination of both. Transformation-oriented planning seeks to change and improve the goals and capabilities of the organization and attempts to bring about these changes. The focus is on redirection of both internal and external forces. It calls for determining a realistic balance between expected and desired ends and courses of action to be taken.

Adaptive-oriented planning, which often takes place through ad hoc reactions to situationally or environmentally-induced constraints and problems, seeks to scramble out of the situation. It often leaves little room for change of organizational ends and capabilities, since it is short-term and reactionary. Whereas transformation oriented planning seeks to identify impending and potential constraints as well as opportunities, adaptive planning seeks to work with the shortfalls with less of an entrepreneurial, developmental organizational impact. Both of these types of planning are included in this chapter.

Planning Flow Processes

The orientation of planning--transformation versus adaptive--is an important issue in examining the flow process of strategic planning. Strategic planning, by nature, tries to identify long-term issues to which planning decisions are addressed. Planning by SBUs or other line organizations tends to be transformation oriented as it examines sales markets and influences which might determine the effectiveness of the organization in meeting sales and financial objectives. It is within functional planning where the distinction between transformation-oriented and adaptive-oriented planning is the most pronounced. Typically functional plans are short-term or operating plan oriented, as mentioned previously in this report. In that light, they tend to focus on adaptive change to constraints as they are imposed on the organization, rather than strategic, entrepreneurial actions.

Flow Process Models

With this introduction of and distinction between planning orientations, planning flow process models can be better understood. Figure 23 provides an overall flow process model for the strategic planning process. A universal model is impossible to present, since the authors found numerous approaches to planning among the companies studied, many of which had basic differences in the flow process of planning. Consequently, this model, and the others presented in this chapter, do not represent "the way it is done by all companies," but rather they represent a cross section of different flow processes as presented by some of the companies studied.

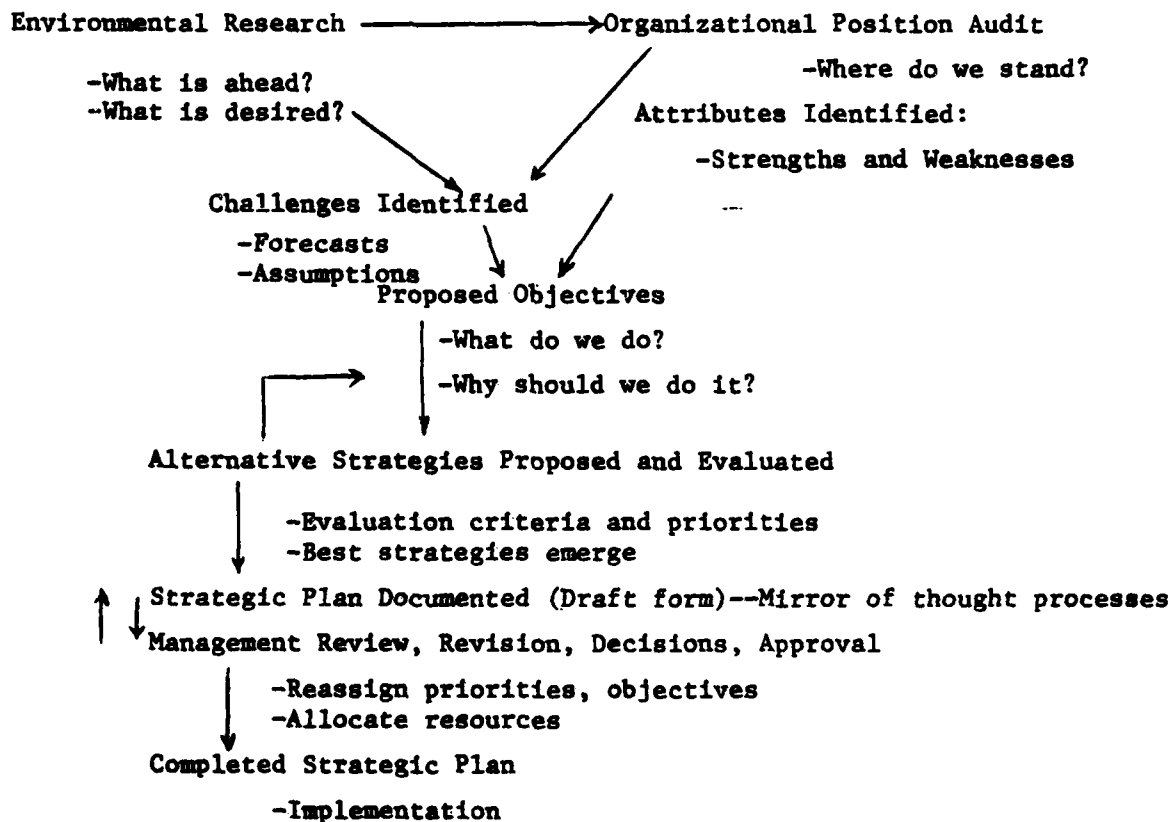


Figure 23 : Strategic Planning Process Flow Diagram

The two key events which start the annual planning process are: environmental research and organizational position audit. The environmental research, which is normally done by a staff of economists, political scientists, and other specialists in world geopolitical and economic studies as well as industry dynamics, provides the data base for the company to respond to in its planning. The objectives are to identify what is ahead and what is desired. Imbalances between these two become planning challenges. The data from environmental research are also used in organizational position audits. These audits examine the capabilities of the company, present and emerging, to determine where the company stands with respect to the information in the environmental research. Organizational attributes (strengths and weaknesses) vis a vis the environmental data are then used to determine challenges for the organization. Challenges are reflected in forecasts and assumptions as to what planning issues should be addressed.

The challenges then provide a basis for proposed objectives for the company or organization (SBU), and these take the general form of what to do and why it should be done. Methods of getting the factors done become alternative strategies. These are evaluated for soundness and feasibility with the objective of determining the best strategies to pursue. Commitment to the analysis and statement of strategies then becomes documented into a formal strategic plan. The draft of this plan mirrors the thought process of the planners. Higher management reviews the draft plan, makes revisions, decisions, and/or approves the plan in a series of iterative exchanges between planners and approvers. The completed strategic plan is then implemented.

Thus, strategic planning involves a thought process of work flow which is formally committed and approved. The following comments on such a process and flow were provided by a manager with one of the companies that was studied:

During the development of our planning system, we instituted eight major changes which modified our operations to reflect the strategic planning process. I won't mention all of them, but the first was a lengthening of our planning horizon.

It became a standing joke around here that our definition of planning was "What's for lunch?" We used to limit our long-range look to five years. However, since the plans were reviewed in the middle of the first year, it really covered only four and one half years. This short time-span in our business was inadequate, and we found that we were really just projecting, not planning. We extended our time horizon several more years. We also added specific questions, such as:

- What is our business?
- Where are we going?
- What are our key assumptions?
- What are the risks?
- Where do our dependencies occur.

We also asked ourselves an important question that goes something like this. Suppose a manager who was in charge of a major division or project leave the company, say to work with the Federal Government for a couple of years. What document should he leave behind to ensure continuity of direction? We believe it should be a strategic plan. It should be meaningful with both narrative and quantitative information and be a stand-alone document.

Figure 24 illustrates the strategic planning cycle as a period planning flow process over a calendar year, and Figure 23 illustrates a milestone planning approach used by one company and the various functional and operating plans involved.

In Figure 24, corporate level guidelines provide the major direction to planning efforts, and these are provided during the initial part of the first quarter. Long range planning activity in the corporate SBUs follows these guidelines. These are submitted for corporate review, and feedback follows. The SBU plans are then developed in the fourth quarter and reviewed for budgets for the next operating year. This cycle involves a rolling five year and beyond time horizon.

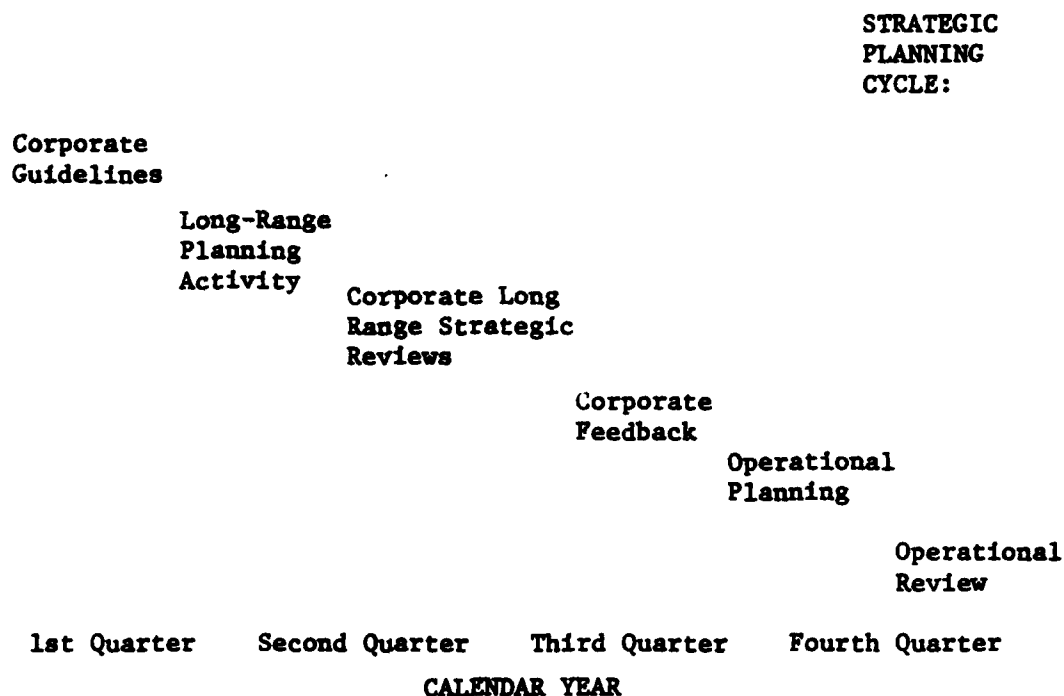


Figure 24: Strategic planning flow cycle

Annual Planning Activity:

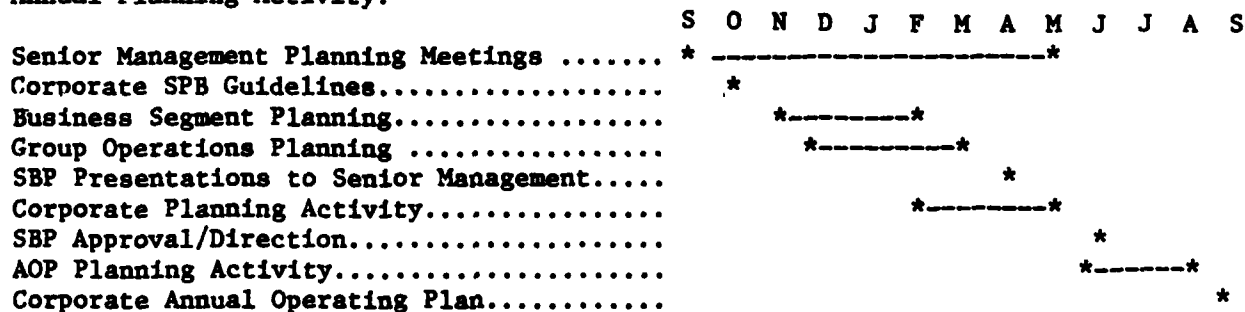


Figure 25: Annual planning events in one DOD contractor organization

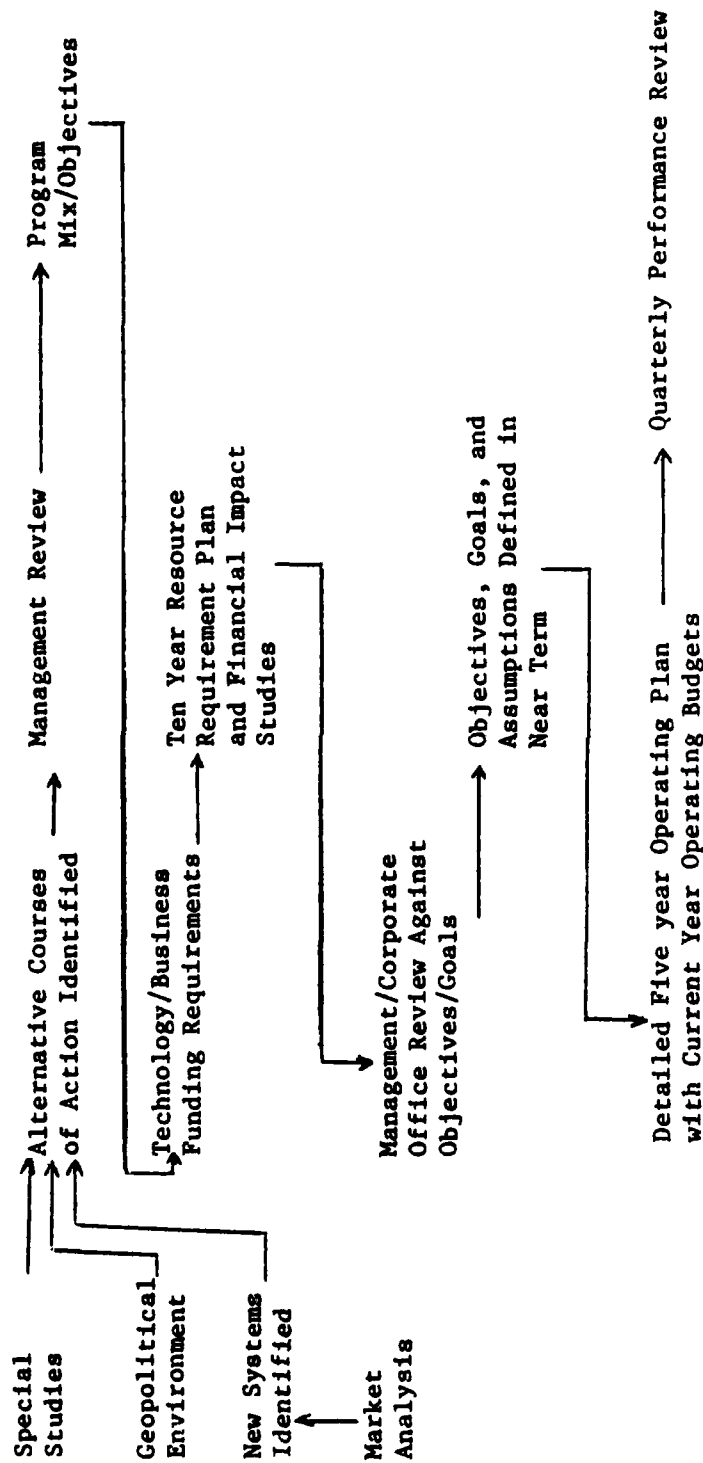


Figure 26: Planning procedure used in one DOD contractor organization

Figure 25 involves planning events on a chart. Senior management meets, normally with a retreat, in September. These planning meetings continue through over half the year with iterative feedback and new information to planning units. The output of the planning meetings begins in October with the formulation of guidelines. SBUs begin planning in November and have major drafts of plans complete by February. Presentations by SBUs to senior management is scheduled for May following group operations planning. When SBU and group planning is being reviewed, corporate level planning also occurs. SBU plans are targeted for approval in July and annual operating plans (one year, budget oriented) are determined in August and September. The corporate annual operating plan (one year) is established in September, and the cycle starts over with corporate senior management planning meetings.

Another company included as a parallel event to this planning process the continual development and revision of functional plans, including a "long range technology plan." Quarterly performance reviews against plan objectives and milestones also occurs through the cycle.

Figure 26 illustrates a different view of planning as presented by another company. This plan has several different factors from the one discussed previously. It includes technology and new business fund requirements as a specific step or procedure, it involves resource planning, and it involves a five year operating plan, rather than a one year one.

One company presented what management termed "advanced planning reports," and these were to be directed toward transformation-oriented planning effort. The reports were in the following functional areas:

- (1) Technical plan.
- (2) Market analysis and bookings plan
- (3) Manufacturing plan
- (4) Facilities plan
- (5) Manpower plan
- (6) Financial plan.

Each of these functional areas looks ahead five-ten years and determines strategic directions and efforts within the function, particularly in support of SBU and other operating plans. Notable among missing

functions or plans was a resource market or procurement plan. In many cases, companies expected this function to be represented within the manufacturing plan, rather than as a separate plan.

Another example of a flow diagram, which came from still another company, is shown in Figure 27 . This plan includes four year projection of resource needs and functional support in the operating plan, rather than merely a one year need.

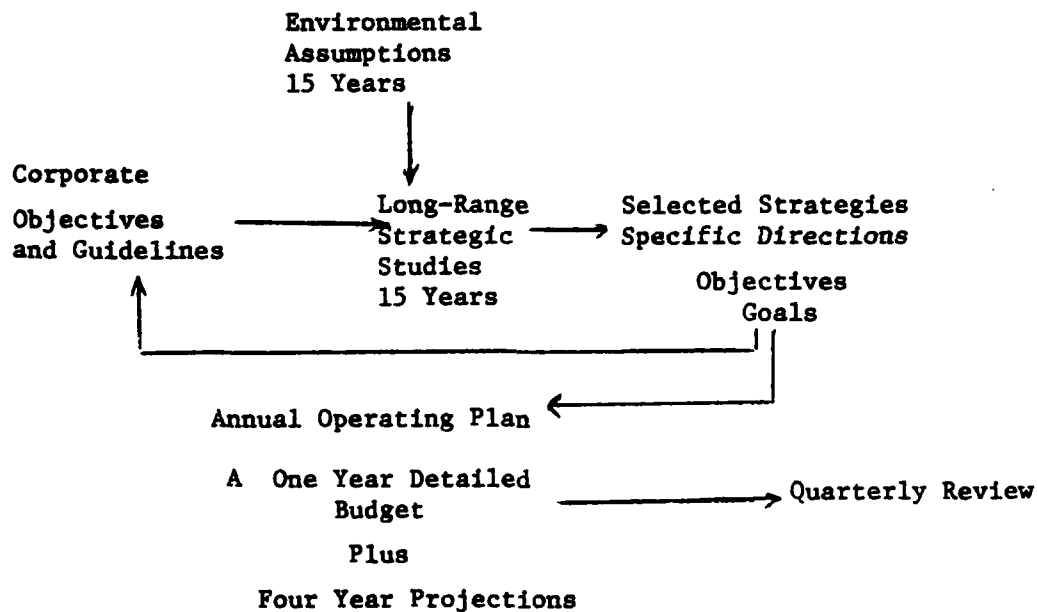


Figure 27: Planning flow diagram.

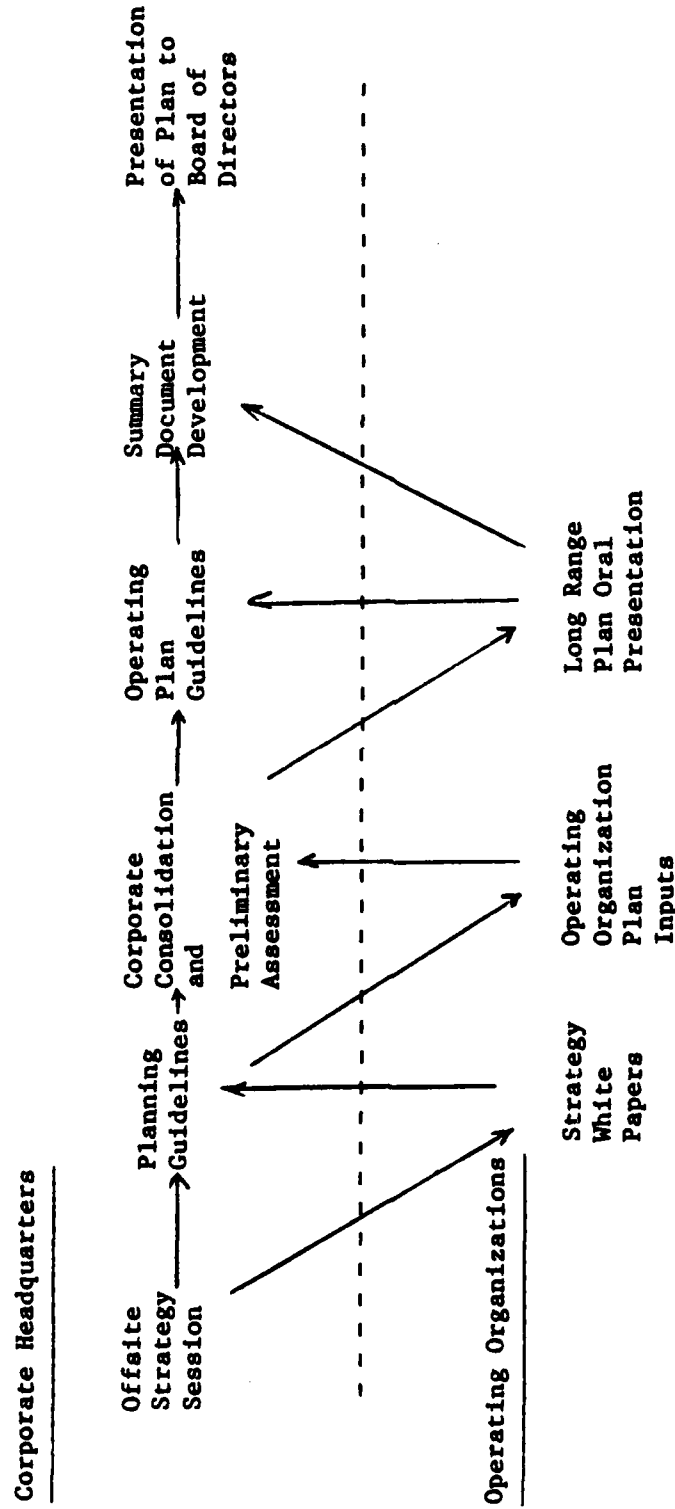


Figure 28: Long range planning cycle, corporate and operating organization responsibilities

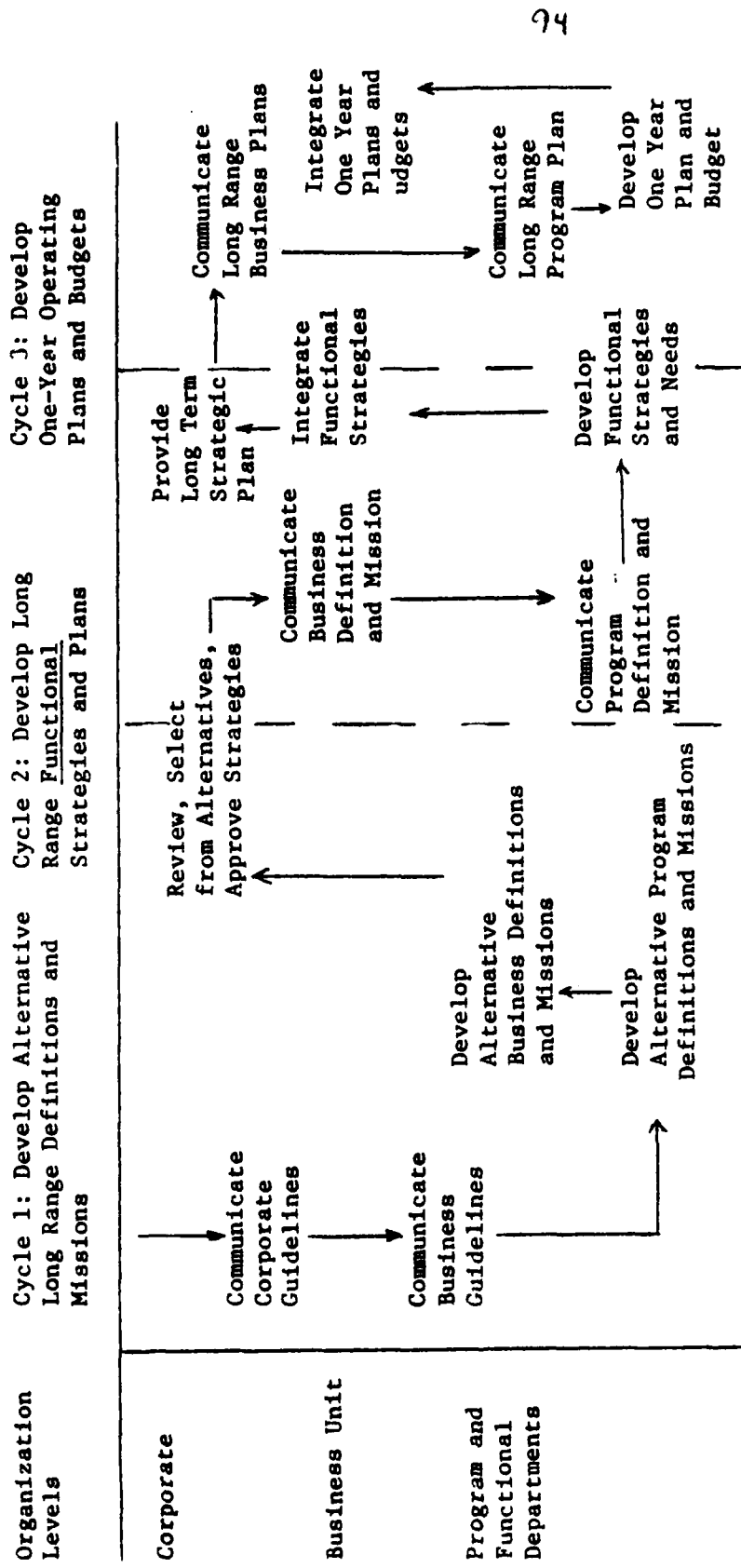


Figure 29 : Model of three-cycle planning process
 Note: Adapted from Abell, D., Strategic Market Planning

Figure 27 shows the contrasting view held in one company concerning the relative roles between corporate and operating organizations. This company had a much stronger role of the corporate office in planning. Offsite (retreat) strategy sessions provided planning guidelines to operating organizations. These operating organizations then formulated what the company termed "strategy white papers," rather than proposed strategic plans. These white papers were then consolidated into a corporate plan and provided back to operating organizations for additional work. The operating plan inputs were then assembled into operating plan (one-four year) guidelines. Operating organizations were expected to make oral long range presentations to the corporate office personnel after which a final strategic plan (corporate) was presented to the board.

Figure 29 provides still another view of the planning flow process and the steps involved. This approach examines three cycles in planning by a business unit. Cycle one concentrates on developing alternative long-range definitions for the organization and the major mission and objective issues for the plan formulation process. This cycle includes the following factors:

- (1) Management summary of key assumptions, alternatives and recommendations.
- (2) Corporate guidelines to the business unit. This includes a presumed business scope, a tentative statement of corporate requirements over a long-term planning horizon (largely financial oriented), and other data. Specific objectives are established in terms of market share, net income, ROI, cash flow, growth and other factors.
- (3) Business and market analysis to determine anticipated changes and key market characteristics to be included in planning.
- (4) Identification and analysis of strategic alternatives.

Business units (such as SBUs) develop alternative business definitions and missions from the examination of these guidelines. Corporate review begins the second cycle. This cycle is largely a functional cycle where the needs within functions, such as manufacturing, human resources, and finance, are determined for support of the long range business definitions and missions. The cycle progresses through further review and development both within programs (products, such as F-16) and functional departments. This then goes into the corporate office for long term strategic plan development and further iteration by the development of one year plans and budgets.

This process provides a relatively "heavy" top down orientation, with not nearly as much lower level or operating unit autonomy as in other approaches described earlier in this report.

Systems of Plans Concept

An area of strategic planning deserving further elaboration has been referred to by several companies as the "systems of plans concept." Essentially, this is a process of integration of plans into a unified plan for the organization, including various business unit and functional plans. The objective is to establish internal consistency as well as a review of total resource requirements and allocations. Figure 30 illustrates a system of plans approach and the specific plans that can be developed within each overall plan category. That is, a mission development plan can consist of sub-plans, such as a divestment plan or a research and development plan.

This approach shows in-depth application of planning as it pertains to specific issues facing the organization, such as divestment, R&D, and regulatory issues. Research indicated that only rarely was the issue of resources from suppliers included in this planning approach. More detail on this is presented in later chapters.

Mission Plan

Functional Plans

Development Plans

- Organizational Development SubPlan
- Financial Development Subplan
- Technical Resources Development Plan

--Divestment Plan Section

--Research and Development Plan Section

Environmental Development Plans

- Vertical Integration SubPlan
- Customer Base Development SubPlan
- Regulatory Interface SubPlan

Operating Plans

Program/SBU Plans

Functional Plans
for individual
programs

Corporate Strategic Plans

Figure 30: Strategic systems of plans concept

Part of the integration process in the systems of plans is the scheduling and prioritization process. Figure 31 illustrates the application of time sequencing of objective sets as priorities are set for specific subplan implementation through resource allocations.

Summary

The purpose of this chapter has been to provide a description of the cycles and flows used by many of the companies studied in this research project. These cycles provide a formal basis for assessing the effectiveness and deficiencies of the resource market interface of the organization, which is the topic of the next section and of the following chapters.

Mission and
Objective
Priorities

Years in Planning Horizon

<u>Objective Sets and Objectives</u>	First	Second	Third	Fourth	Fifth	Priority
Objective Set 1:						
Management Development						
1. Needs Analysis	X					2
2. Formal Training		X	X			3
etc.						
Objective Set 2:						
Market/Products						
1. \$50 mm sales		X				5
2. New technology	X					1
3. New market				X		7
etc.						
Objective Set 3:						
Supplier Development						
1. New sources for commodity A.			X			4
2. Make component B in-house						6
etc.						

Figure 31: Scheduling, Prioritizing, and Sequencing of Objectives in the System of Plans

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References

Materials in this chapter were taken from data provided by contractors

Chapter VI

STRATEGIC PLANNING IN HIGH TECHNOLOGY COMPANIES

The purpose of this chapter is to address in more depth than in previous chapters, some of the specific problems and concerns of organizations producing and marketing high technology products and services--the segment in which those who are prime contractors to the Department of Defense fall.

Technology in Corporate Planning

The technology side of business operations tends to be an under-developed aspect of strategic planning. General managers often lack an intuitive feel for strategically directing and positioning research and development efforts and investments as compared with similar investments in marketing, production, and sales. Technology issues either tend to be downgraded in strategic plans or only implicitly addressed. There are many reasons for this phenomenon:

- (1) Top managers often have their backgrounds in non-technical functions, with limited training in science and engineering.
- (2) Corporate economists fail to recognize the process of technological change in their forecast/models. Marketing research is also quite weak in the technological field.
- (3) There are limited frameworks of understanding concerning the process of technological change.

Author's note: Many of the concepts developed in this chapter were obtained through the assistance of Pugh-Roberts Associates, and the authors have made liberal use of their ideas as well as their own.

- (4) Significant technological change often requires ten years to materialize. Although many companies have five year plans, some 90 percent of their R & D activities are aimed at implementation within three years. This is largely due to maintain short-term cash flow objectives and justification of R & D flows.
- (5) Many strategic plans address technology as a "step-child" in a support role to implement other strategic objectives.
- (6) Most corporations are organized around production and marketing activities. Often most significant technological changes occur outside of the organization.

In only three areas of strategic planning has technology been used quite widely and explicitly: (1) Acquisition of new technologies from outside the company in the process of corporate development, (2) Licensing of technologies, and (3) New venture activities. Yet technological issues enter as a result of activities both inside and outside the company and the industry. They can influence the entire corporate situation-- manufacturing, materials procurement, marketing, and financial, to name a few. So key questions emerge for strategic planning:

- (1) How are technological issues identified and used in strategic planning with explicit analysis as done with tangible, product factors?
- (2) How has management used technology to implement strategic objectives?
- (3) How has technology been monitored and fostered?
- (4) How are activities relevant to technology recognized and organized in the company?

For starters, there are seven dimensions of technological strategic applicability to product acceptability alone. Technology can influence functional performance, acquisition cost, ease of use, operating costs, reliability and maintainability, service incidence, and compatibility with the larger system. Each technology attribute (such as the seven noted above) should be assessed for their elasticity impact upon market/program target segments of customers. That is, some customers may be more interested in functional performance benefits from technologies than others, who, in turn, might be more interested in life cycle cost. In this manner, directions of technology toward attribute development can be matched toward market impact targets.

However, technology has implications beyond customer/use applications. Both outside and inside challenges put pressures on companies to improve strategic planning models in the area of technologies in many directions. Significant outside challenges include increased foreign competition, increased cost of money, increased scarcity of raw and semi-finished materials, new end-use technologies, and increased capabilities in manufacturing technology.

But technological planning is frustrated by internal problems. Two main ones are (1) dispersed strategic responsibilities, and (2) lacking strategic planning discipline. Strategic responsibilities for technology planning lie across many functional departments. Although most R & D efforts are centered in engineering, technology programs and decisions must also be addressed in manufacturing, marketing, new product planning, and by senior management. If technology planning applied only to engineering, it might be well to consider it as "adequately covered" by that function. However, since it impacts significantly upon other functions--especially

issues of technology with outside organizations such as customer technology changes and supplier technologies--there is no one "home" for strategic technological planning.

Further, strategic planning does not have one "home" either. Although corporate and divisional organizations have strategic planning staffs, as indicated in previous chapters, these serve primarily in an advisory/guidelines role and only provide economic forecasts in most organizations. Consequently, with the responsibility for strategic planning also dispersed within the organization, there is double jeopardy that strategic technological planning will "fall through the cracks." Organizationally, many departments, such as manufacturing, are structured and managed toward tactical, operational procedures, rather than strategic thinking, and the reward structure focuses on nearer-term gains.

As a result of these dilemmas, strategic technological planning as it pertains to focus on the technological underpinnings of strategic customer and resource market development is a very neglected area. The result is limited or non-existent development of organizational capabilities to do technologically-based market planning and to respond effectively.

Elements of Technology-Based Strategic Planning

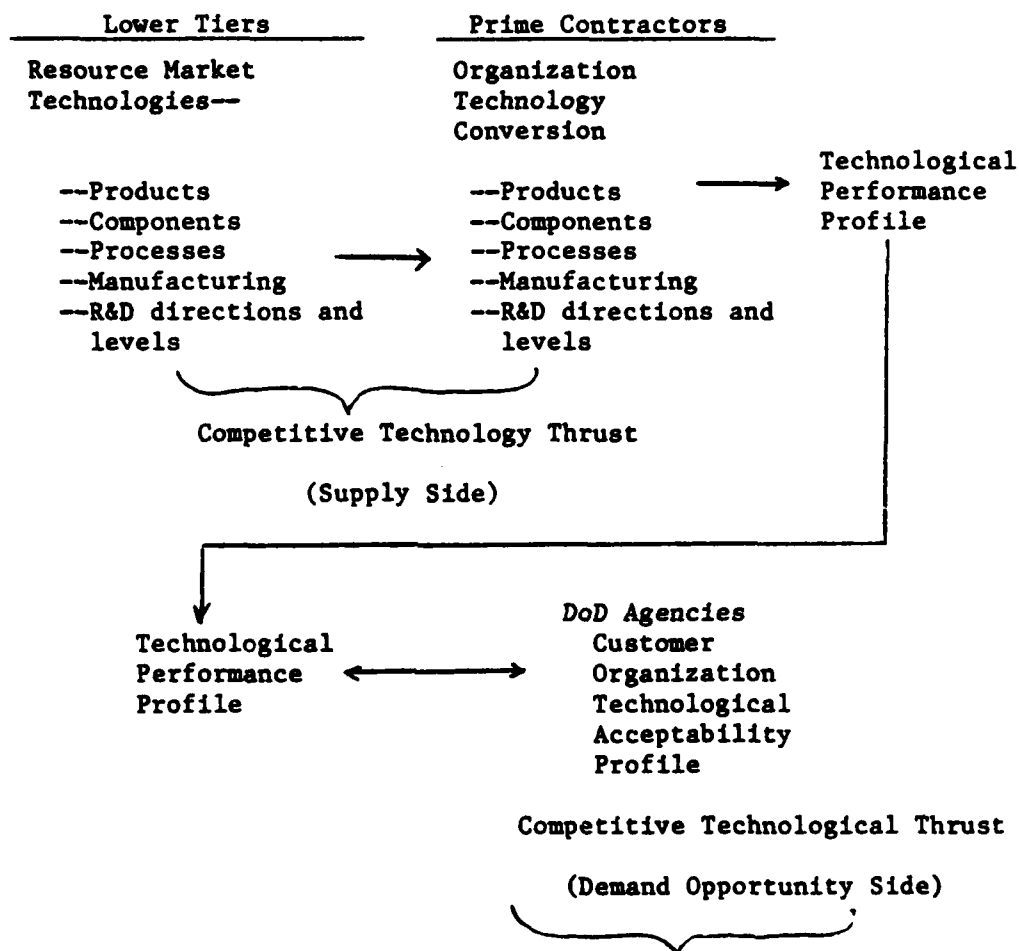
There are six main elements of technological strategic planning:

(1) identification of technology planning units (TPUs), (2) determination of environmental segments along technical dimensions of product differentiation, (3) assessment of present and future technological competitive strengths, (4) assessment of technological elasticity impact of product/customer portfolio planning, (5) assessment of inside strengths and interorganizational strengths in technological synergy, and (6) selection, planning, and strategic control of technological developments.

What is a technology planning unit? Organizations, particularly manufacturing ones, provide conversion of materials and technology into products and services to provide a product performance profile as shown in Figure 32. The access and acquisition of technologies from the resource environment, together with the internal value added of technology, determines the product/program offering's competitive technological thrust. The interface of this thrust with customer technological demand and acceptability determines the elasticity or propensity to develop competitive advantage through technological directions. A technological planning unit links resource technologies with internal technologies toward customer technological acceptance criteria.

Figure 32 is based upon interorganizational dependency at two ends of the spectrum--resource market dependency and customer market dependency. The organization providing the technological conversion is dependent upon resource market technologies to combine to provide a competitive technology thrust (against other competitive systems) from the supply side. This supply thrust is the technological performance profile--and has a time dimension to it. The performance profile is an on-going, emerging capability as well as a specific capability at a point in time. From the customer side, alternative customer segments provide criteria for technological acceptability (performance, life cycle cost, etc.) according to various priorities to customer units. These constitute the competitive technological thrust from the demand side. Why competitive? These customers are competing for the efforts of supplier units. For example, the Air Force competes with the airlines as customer units for the technological efforts of Boeing, Lockheed, McDonnell-Douglas and so forth.

Technological Planning Units



Technology Planning Unit Concept

Figure 32: Technological Planning Units

This will be developed more thoroughly later. The combined opportunity/performance match is called a technology planning unit and represents a marshalling of resources (external and internal) to meet a specific, defined technological opportunity. Such a technology planning unit is a "strategic window" for the company.

Inherent in the technological planning unit concept is the need for an interorganizational focus in strategic planning. This focus examines the technological demand and resource markets in two directions--the user market to whom the prime contractor markets the system or high technology product, and the resource market which comprises the high technology components and subsystems which are acquired from specialized lower tier firms. In this setting, the prime contractor plays a facilitative role in (1) identifying and interpreting the technological system/end use product opportunities for both the prime contractor organization and the lower tiers--reducing risk in technological planning, and (2) providing liaison in assuring that lower tier technological strategic planning and technological development is proceeding in the correct scope, direction, and level to meet the timely, cost-effective, and performance capabilities to be demanded by the customer(s). The resulting integrated strategic planning for the system of interfacing companies and organizations expands the role of the prime contractor beyond his own internal organizational technological planning efforts into an interorganizational technological systems planning approach.

There are significant differences among customers' technological preference sets and hence different technological market elasticities. Analysis of alternative customer segment preferences and elasticity scenarios is a key effort in systems planning. Several important criteria

exist for separating technology markets/environments. These are (1) the shape of the technical demand profile, or customer technological preference profile, (2) the nature of variables in this profile, (3) the degree of similarity of technologies among various customer segments which will allow for technological leveraging, (4) the potential interchange within these spin-off segments, and (5) the potential for gaining learning/experience based advantages within the technology.

When a technological planning unit is determined, such as an approach to target sensing for a missile or an avionics system, it is important to go several steps further in examining market opportunities. Different segments have different technological demand profiles. This begins with utilizing a general set of key technical dimensions for describing the technological planning unit (TPU). For example, performance, per se, is too broad. More precise performance specification options must be examined. Maintainability and life cycle cost is also an example of a technical dimension of a TPU. When these are identified, management must evaluate the specific elasticities of response of each dimension of the TPU across the relevant market segments. This customer-determined segmentation is then subjected to design review to provide a product design influence (from the producer) on the "product" under consideration. This involves the matching of opportunities with company capabilities for fit and maximization of competitive strengths.

The next phase involves trade-offs among various customer segments and technological preferences compared with technological capabilities and the costs/time dimension of developing these capabilities. This may also include scenarios concerning different patterns of usage and concerns of

the user in the operating environment. Figure 33 illustrates an example of this approach for commercial refrigeration.

<u>Technological Dimensions in Product Development</u>	
<u>General Technical Set</u>	<u>Technology Product Response</u>
Functional performance	Pull-down rate and capacity
Acquisition cost	Front-end price
Ease of use	Performance features
Operating/life cycle cost	Energy consumption
Reliability	Incidence of service calls, expected operating life
Serviceability	Cost per service call
System compatibility	Size, shape, color, integration logistics

Figure 33: Technological Dimensions in Product Development

The next step is to evaluate demand elasticities with technological trade-offs. For each technological dimension, management should determine the percent change in market demand for each percent change in performance along a technical dimension. For example, for each ten percent reduction in size and weight of an electronic calculator the market expands five percent. The elasticity ratio would be 0.5. However, there are two kinds of technological demand elasticities, absolute and partial. Absolute technological demand elasticity determines market size for a market of interest, and is the percent change in industry volume per percent change in industry technology. Partial elasticity, which determines market share, is the percent change in company business per percent change in company

technology and includes the competitive technology change assessment in the strategic planning.

Figure 34 illustrates a graphical presentation of partial elasticities of technology demand for medical equipment between two segments: hospital emergency rooms and physicians' general practice offices. In this example, technological attributes (dimensions) which are more similar between the segments (acquisition cost, ease of use, operating cost) provide a potential for more technological leveraging across the two segments than do dimensions which are much different (such as function, reliability, or compatibility). In the latter case, these dimensions have a major incremental appeal to one segment, but not to the other. A technological product profile emphasizing function and compatibility, for example, may have good market penetration in hospitals, but would do relatively poorly in physician's offices in the absence of other attributes. A manufacturer who chose to invest R & D dollars in these dimensions would be aiming his technological product toward the hospital market, at perhaps the exclusion of the other segment. However, a more balanced technical strategy would be to aim for both segments and put most of the R & D monies into dimensions with good commonality of appeal. This approach has major overtones for the military versus commercial applications markets to be discussed later in this report.

When such a product planning profile is established by a first-tier, prime contractor organization, it must then be interpreted for lower tier organizations whose technological efforts may concentrate on one or more technological dimension, such as pull-down rate, or maintainability for a compressor in the refrigeration unit. In more technologically complex products with many operating subsystems, such as aircraft, this

planning/interpretation process becomes much more involved both in terms of the number of subsystems and technological dimensions of each subsystem, but also in terms of the number of lower-tier organizations with whom to coordinate the system technological planning.

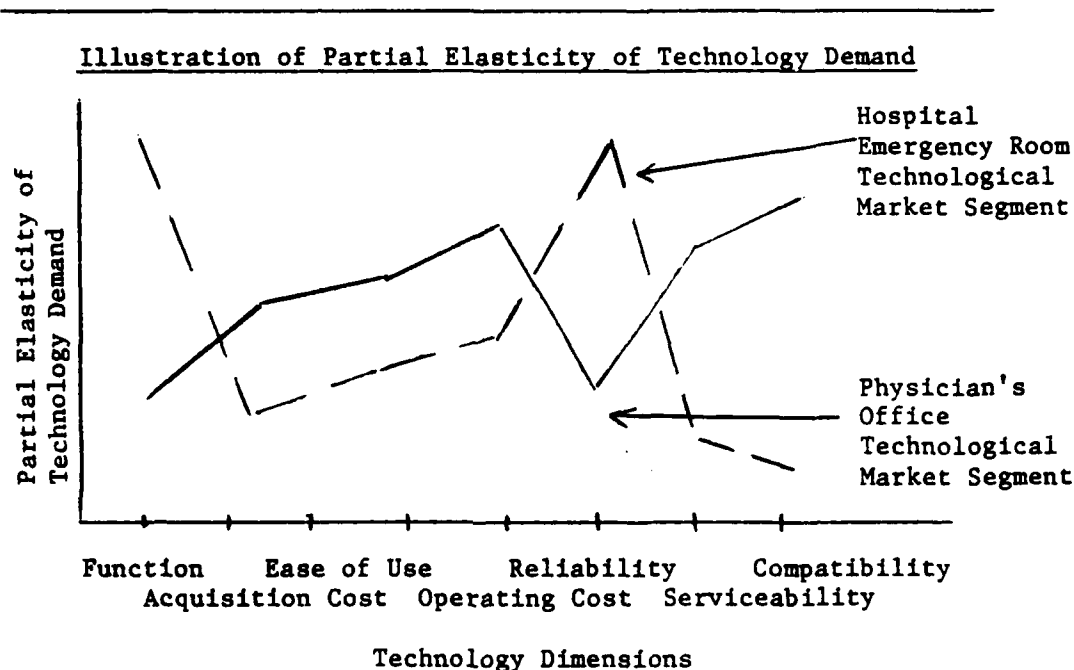


Figure 34: Partial Elasticity of Technology Demand

Figure 35 provides a current/future orientation to the assessment of technological dimensions for two different kinds of products as an illustration of these time horizons applied to technological dimension strategic planning. Consequently, the technological profile under coordination by the first-tier contractor as well as the product life cycle potentials for the various interrelated organizations who are depending on the demand.

Strategic Time Horizons to Technological Dimensions

<u>Technological Product Category</u>	<u>Present Market Demand</u>	<u>Market Demand in Five Years</u>
Filtration of Pharmaceutical Preparations:		
Bacteria removal	High	Low
Flow rate	High	Moderate
Filter costs	Moderate	High
Equipment costs	High	High
Reliability	High	Moderate
Maintenance costs	Low	Low
Ease of set up	Low	Moderate
Fiber Extrusion for Commercial Carpet Fabrication:		
Appearance (new)	High	High
Wear rate	Moderate	Moderate
Appearance (old)	High	Moderate
Cost per yard	Moderate	High
East of installation	Low	Low
Flexibility in use	Moderate	Low

Figure 35: Strategic Time Horizon and Technologies

These two examples come from analysis of broader, environmental data, such as inflation rates, cost of money, as well as specific expectations of priorities in product selection criteria by buyers in the two different time horizons. This provides a technological direction scenario for lower

tier organizations, such as fiber chemistry R & D and fabrication as a subordinate industry tier to carpet producers.

Figure 36 illustrates the use of a technology/product matrix to show an assessment of the inside strengths and portfolio synergy for a line of related products. Among six different generic technologies being explored by a company, six different products were developed in the cells of the matrix which are marked T/P. In only one instance was the company able to

Technology/Product Portfolio Synergy Matrix Analysis

	Product Portfolio					
	A	B	C	D	E	F
1	T/P	T/P	T/P			
2				T/P		
3					T/P	
4						T/P
5					T/P	
6					T/P	

Technologies

- 1 -- Particle Separation
- 2 -- Metal Fiber Formation
- 3 -- Molded Material Formation
- 4 -- Noise Control
- 5 -- Statis Elasticity Control
- 6 -- Energy Conversion

Product Portfolio

- A -- Industrial Pollution
 - B -- Commercial Filtration
 - C -- Medical Filtration
 - D -- Construction
 - E -- Wall/Floor Coverings
 - F -- Automotive Engines
-

Figure 36: Technology/Product Portfolio Synergy Analysis

combine technologies for a specific product application--wall/floor coverings, and in no instances was a generic technology leveraged over more than one generic product. This represents a relatively poor utilization of technological/product synergy. Where technologies are expensive to develop, inability to identify at least some sales market/product offsets to leverage the R & D costs either greatly increases the costs of the thin product applicability that is found or prevents R & D levels from being significant, or both. The determination of the company/division strategic market posture comes from examination of the internal capabilities (and technological planning unit support) to fulfill market demand for technology within a strategic time dimension. Future posture and direction for technological dimensions of demand are a function of (1) review of present technical programs for needed changes, (2) review of internal strategies for product positioning, customer evaluations, and market research activities, and (3) determination of required actions to remain viable based on competitive and market trends. Figure 37 represents a flow diagram for strategic planning for high technology organizations.

Such a dynamic, complex technology/product strategy formulation procedure requires important changes in organizational structure and relationships. An important factor is utilization of joint technology-marketing-manufacturing-engineering-procurement teams for rough assessments, forecasting, and capabilities analysis. Focus should be on key executive questions through interpretation of data for strategic opportunities consistent with current and planned strengths. In this capacity it is important to work with similar organizational units in both customer and supplier organizations.

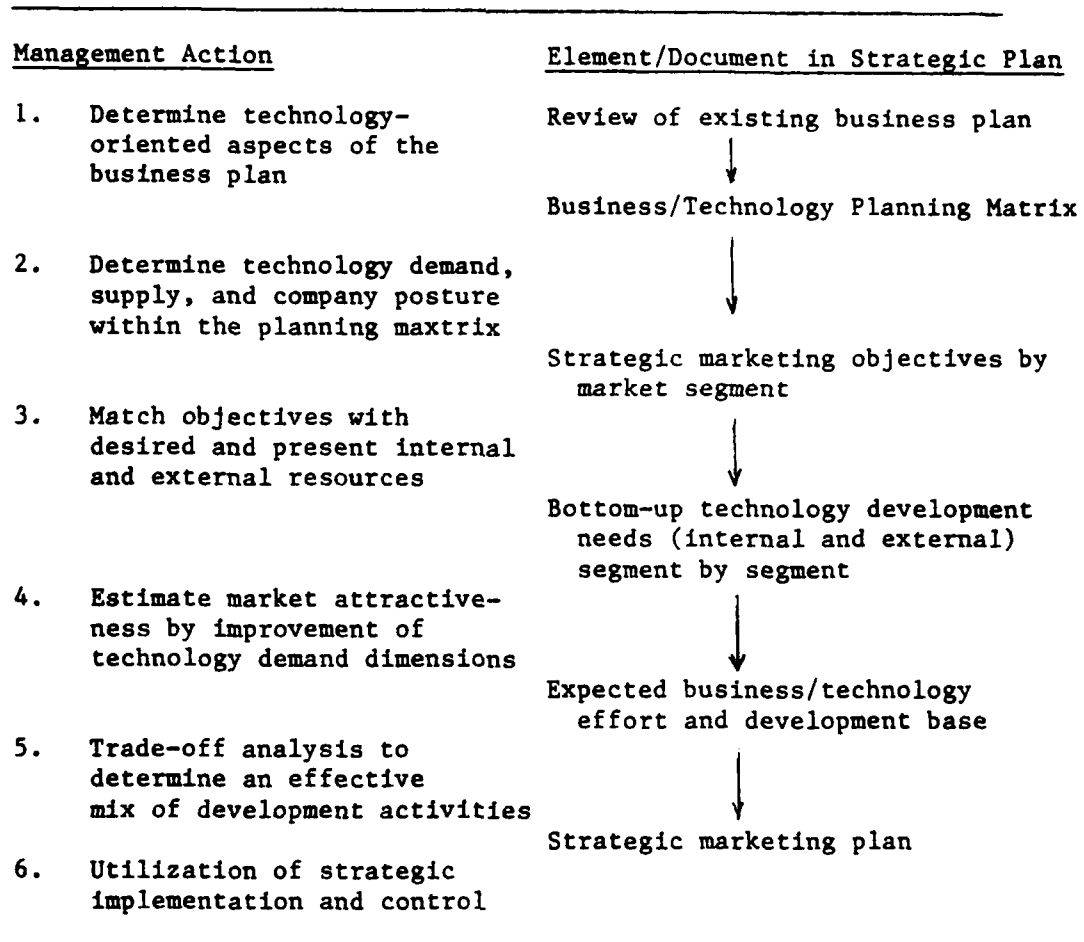


Figure 37: Strategic Plans in High Technology Organization

Technology Access and Transfer

Another important dimension of strategic planning for high technology organizations is the access to and transfer of technology between organizational entities comprising the technological planning unit. Executives involved in several surveys on technology planning and transfer agree on at least one point: technology can be planned and transferred most effectively when the buyer and seller organizations maintain their relationships with each other over a long time period. Licensing

provisions that include the training and passage of know-how tend to be the favored method.

A key strategic decision is determining the future, long-range accessibility of technology and balance in strategic aspects of external technological dependency. Accessibility of technology can be through a variety of forms, although there are three main categories: direct purchase of technology from an outside source, internal development and growth of technology, and indirect access to technology through procurement relationships. It is the latter case, which is primarily of interest in this report.

Strategic plans should address specifically the technology development and access policy and strategies to be employed for each key component of technology needed in support of the planned technology/product portfolio. This includes planning of expenditures both internally and in association (teaming agreements) with key suppliers, and these should be explicit objectives and strategies in the strategic planning process.

Technology planning involves several risks, such as technical risk, organizational risk, investment/cost risk, and market risks. Technical risks pertain to the capability of the organization or the TPU to actually develop the state of the art of the technology as planned. Organizational risks include factors in both organizational arrangements and relationships as well as proper management incentives and motivation and control devices to bring to pass the long-range technological objectives. Investment/cost risks pertain to the recoverability of expenditures for technology in terms of discounted cash flow from eventual product sales, while market risks pertain to the changes in market demand and elasticities which are uncertain and which could yield a technology obsolete before it is brought

to market fruition. Where technology is acquired directly or indirectly from suppliers, these risks are multiplied within the organizational dynamics of another institution or set of institutions, over which the recipient may have little direct control.

The senior purchasing executive of a multinational vehicle manufacturing company (automotive) made this comment concerning incentives for suppliers to invest in performance and manufacturing technologies:

In the mid-1960s we carried out an extensive research into major suppliers as regards to their ability to meet our forecasted needs for a forward period of planning. Following the report of inadequate preparation being made by suppliers to alleviate difficulties associated with such things as a shrinking labor force, old equipment, and an extremely low level of investment, we came to the conclusion that we had to influence our suppliers ourselves if we were to safeguard our forecasts of future demand and our forward supply position. We had to convince them that our forecasts of future demand were meaningful in order that they would have confidence to invest.

Summary

The purpose of this chapter has been to present some of the issues in strategic planning which are characteristic of the high technology organization--those factors in planning which companies with low technology operations can usually ignore. Technology is a difficult and often overlooked part of strategic planning for several reasons, although decisions in long-range technological planning and commitments have major effects on capabilities in future years.

Several elements of technological planning should be included in the strategic plan, and this chapter addressed what these are and several ways of developing them. A major concept is the technological planning unit, involving the interorganizational interface of technological needs and capabilities among customer, prime contractor, and lower-tier relationships. In this relationship, the prime contractor plays a key role

in orienting the lower tiers toward coupling opportunities for their specialized technologies to fit with planned prime contractor systems efforts. Technological strategic planning should include objectives in supplier technology interface and development programs to meet customer needs and the ability of the prime contractor to leverage technological risk for himself and for suppliers is a critical factor in his own product/market portfolio analysis. In this regard, assessment of strategic dependency on supplier technologies and mechanisms for transfer should be a part of the strategic planning process.

Technological planning becomes especially important to companies under the implementation of A-109, in that if the DOD acquisition environment is really one of competing differential technical concepts--not aircraft to aircraft--the implications upon the product/technological mix of companies is large. If a particular mission opportunity will not necessarily be awarded to the best, say, aircraft design, but perhaps might go to a missile instead, then to have a chance of success on the planned mission need in the future, the company must be able to consider various technical options to explore, otherwise it may find itself developing an infeasible or lesser feasible technical solution and not just a poorer airplane. Further, lower tier companies then may be able to orient their technologies toward different system concepts and wherein in the past a supplier may have worked just on aircraft avionics, for example, his technological profile now might need to include missile seeker technology to be able to sell to the same mission-oriented end market which formerly was an aircraft end market.

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Chapter VII

THE EMERGING STRATEGIC PERSPECTIVE OF MATERIALS MANAGEMENT

The purpose of this chapter is to introduce the emerging strategic perspective of materials management, the entrepreneurial and proactive role of the procurement function in the high-technology/aerospace/defense business, and the role of long-range, strategic planning in the materials management function. This introduction is made from conceptual materials developed from the literature, from materials gathered in interviews with managers in the companies participating in this study, and from new materials developed by the authors.

Acquisition Behavior in the Aerospace Industries

In order to develop the strategic perspective of materials management, it is important that the authors explain a continuum of perceptions of the role of the acquisition function in the aerospace industries at all levels and tiers. Much of the material in this section is adapted from the work of Eric Von Hippel of MIT, and references to his work are provided at the end of the chapter for those interested in additional material.

Paradigms of Initiatives

Traditionally the exchange process in the marketplace follows what might be termed a "manufacturer active paradigm." Under this approach the manufacturer or marketer determines product/market opportunities, develops products, and provides them to the customers. The customer/buyer is a relatively passive recipient of this marketing initiative and merely responds with a "yes/no" concerning the proposals. Program ideas come from marketing research, not from buyer solicitations. Many industrial transactions, and nearly all consumer product transactions, follow this approach. The buyer's role is merely one of accepting or rejecting what the marketer offers, indirectly driving the nature and content of products and services provided.

At the opposite end of the spectrum regarding the relative role of buyer/seller in "driving" the exchange process is the "customer active paradigm." The customer/buyer determines the specifications, performance capabilities, timing, pricing approaches, delivery and other important terms incident to the exchange process. The marketer merely chooses to respond, "yes/no" to the directions of the buyer. Communications initiatives are directed from buyer to seller and the buyer often takes on the role of motivating the interest of prospective sellers. The DOD acquisition process, although not entirely customer-active, is a classic example of a major role for the buyer driving the exchange process. Much of this comes about through the statutes and policies governing DOD's interaction with the industrial base. Such factors as pricing guidelines and procedures, methods of proposal solicitation, and others provide specific approaches to be followed in the customer-active paradigm.

One of the main reasons for customer-active exchange processes lies in the nature of high technology products. Many high technology products are developed to be "customer-specific" and to solve a precise package of benefits meeting the needs of a select customer. This basis for customer-active exchange, consequently, goes well beyond the DOD arena. Few, if any, products are sold to DOD or similar customers from a supplier's "ivory tower drawing board."

Specific directives have attempted to moderate the customer-active paradigm of DOD. Specifically, such a paradigm can be so customer driven that it diminishes competition and creative initiative by the sellers. Overspecification of systems can not only restrict competitive opportunities, but also limit creative solutions by contractors. Figure 37 illustrates the continuum of active-passive involvement for a buying organization according to the contrasting paradigms discussed above.

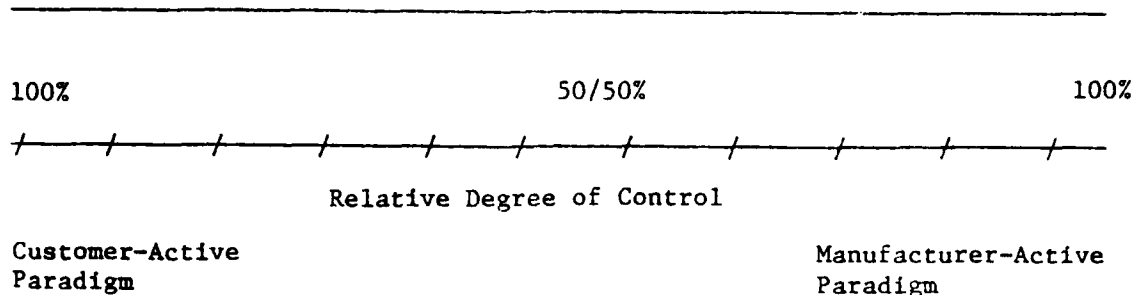


Figure 37 : Continuum of Customer and Manufacturer-Active Paradigms in the business exchange process.

This concept applies not only to the relative degree of control or driving of the exchange process, but also to the role of the buyer-seller organizations. For example, a buyer may determine basic operational specifications for a required product, but leave the funding of research and development efforts, the pricing methods, and design configuration to the seller. One manager interviewed explained this exchange process this way:

We try to get the supplier to provide what we need through describing a requirements scenario and extract from them the best thinking over a period of technical dialogue. We need to exchange what we know for what they know. Most of our success where we have been able to understand, conceptually, our suppliers, we have the capability of describing and translating ideas into applications. We are not in the business of backward integration, but we must try to extract from our suppliers what they are doing technologically and then convert that to applications. That is only the first step. The next step is to exposit to them what we are doing and then get them to translate that into applications of their technologies (emphasis added).

The manager went on to say that there is a hazard in a customer-driven acquisition style in that sometimes engineers agree to something and a supplier "goes off and does what they agree to and sends a bill." He cautioned for the need of control of obligations and commitments in this style of supplier interaction.

In further comment this manager noted that in several segments of industry that supplied important components to his company, suppliers had declined to produce needed components that were considered as "transitory requirements." That is, when an order went in for a specific quantity for a high technology item to meet the needs for a program for a few months, the quantity forecasted was determined to be insufficient for the supplier to remain committed to supplying the item. The manager noted to the researchers:

The only way we can get such a supplier to accommodate us is to give him our long term ideas and plans and exchange information on what we will be doing in the future and how a specific component will fit in. We have done this in many cases through supplier seminars, and we have had a great reception for them. We provide them information for the "out years," with no firm commitments, but at least with our plans for specific "critical" components.

This shows another example of how the role of a buyer might be used to actively--practively--direct and administer the planning process of a supplier to induce decisions to support long-term needs.

Extended Procurement Organization

Before moving forward into analysis of strategic issues and planning for procurement, it is important to understand the nature of the procurement organization in high technology companies. Although most organizations have a formally established procurement, purchasing, or materials management organization, not all procurement functions--or more precisely supplier interaction and initiative functions--occur through the procurement organization. As mentioned earlier, engineers and other technical personnel become involved with suppliers and potential suppliers in the course of their efforts. Manufacturing personnel often become involved with suppliers during various stages of the acquisition process, as do personnel from accounting/auditing, and even from marketing. Consequently, when one thinks about the relative active-passive role of procurement operations and supplier initiatives, the formal procurement

organization is not necessarily the only focus. In fact in high technology organizations characteristic of the aerospace industry, the procurement organization may occupy a relatively small role in the overall interorganizational relationships process. Thus, it is the relative proactive, entrepreneurial manner of all personnel who do or should interact with suppliers that is being judged, and not merely the efforts of procurement personnel, per se.

This phenomenon can cause an organizational expectation about the role of procurement which can become relatively tactical and short-term in focus. Engineering and manufacturing do the long-term strategic and technological planning and focus with suppliers, and procurement personnel merely write and administer contracts. With such a perception, not only are there problems of coordinating initiatives with suppliers, but also the responsibility for strategic and long-term supplier relationship and procurement plans is not functionally defined. Since the engineering and manufacturing operations center their expertise and orientation toward their own in-house decisions and problems, and interactions with suppliers are on an ad hoc basis and not part of their defined central responsibility, they are unlikely to spend much effort on identifying strategic issues regarding suppliers. They are also unlikely to spend much time developing strategic plans for addressing supplier and resource issues.

With the procurement/materials management organization operating largely from a tactical mode--selecting sources for specific supplies, negotiating and administering contracts, for example--they too are unlikely to be managing relationships and issues concerning suppliers from a long-term, strategic perspective.

In the high technology environment characteristic of the aerospace industries, technological complexity places a major role on the engineering function in supplier relationships, and the multi-tier nature of the industry structure--smaller firms selling specialized, high technology components to other companies who are assemblers--the lack of clear strategic definition of procurement roles becomes a potentially serious problem.

Internal complexity of the informal, extended procurement organization results in a diffusion of responsibility for the function of procurement, and, consequently, for formulating functional strategic plans relating to this part of company effort. Figure 38 illustrates from empirical research the diversity of the extended procurement organization in a variety of industries and the diversity of tactical roles in procurement management. This research illustrates the large role which top management plays in the purchasing process as well as the diversity of influence. It does not include, however, responsibilities and roles for strategic decisions, planning and efforts other than tactical requirements generation and sourcing actions.

Charter and Role of Procurement

Faced with changing production and marketing strategies over time, a procurement function evolves to meet the company's requirements to respond to a changing environment. Historically, when marketing operations or suppliers were relatively undeveloped and the concentration of business strategy was on production and cost control (through efficiency and automation), buyer organizations often focused on supply strategy which emphasized cost competition among vendors. Suppliers and buyers often located plants in areas adjacent to major buying/selling industries, and this was the extent of strategic decisions.

As vendors developed increased sophistication in marketing, the focus in management changed from a preoccupation with cost efficiency toward differentiation of products and services, and a buyer's market emerged. Traditionally, the purchasing function has operated as agents who are part of or an appendage to the manufacturing operation. In this role, purchasing managers are charged with goals subordinate to manufacturing interests and the classic definition, "Getting the right materials, at the right time, at the right price, and in the right quantities. Buyers merely had to exercise tactical effectiveness in placing orders and in playing off suppliers' competitive initiatives against one another.

Company Functions Involved:										
<u>Purchasing Engineering Manufacturing Accounting Sales/Marketing Top Management Other</u>										
<u>Stages in the Buying Process for Capital Equipment</u>										
Initiation*	7	14	20	4	3	12	10			
Specification**	7	15	21	1	1	6	4			
Approval of Purchase***	2	1	11	5	2	14	10			
Search****	22	11	12	5	2	10	7			
Selection of Supplier *****	8	9	17	4	2	13	11			
Formalization*****	24	6	7	8	0	10	14			
Evaluation*****	18	11	18	0	2	6	20			

Data show number of companies out of 31 studied, indicating that this function was involved in the specific stage in the buying process.

- *Includes: need recognition, fact finding, and general solution.
- **Includes: specific solution and preparing of written specification.
- ***Includes: administrative review and approval of the purchase of the item, prior to sourcing.
- ****Includes: supplier search, acquisition of proposals, and evaluation of proposals.
- *****Includes: Negotiation and evaluation with prospective sources.
- *****Includes: Negotiation, contract, and payment.
- *****Includes: Performance evaluation, and satisfaction judgments.

Research included a variety of industries buying capital equipment.

Figure 38: Role of the extended procurement organization in capital equipment purchases
Source: Adapted from Johnston, W., and Bonoma, T., "Purchase Process for Capital Equipment and Services," Industrial Marketing Management, October 1981

Technical skills in purchasing included the ability at cost analysis, negotiation, bid tabulation, contract form and content, basic legal provisions, and delivery and expediting skills. The emphasis on purchasing was procedural.

However, as both supply markets and customer markets changed, particularly in the past decade, the purchasing function has had forces for change, although many purchasing operations have tried to resist this change. Materials management evolved in the 1960s and the function began to be identified organizationally as separate from manufacturing. However, materials management with its emphasis on total materials performance is still largely tactical in scope. Strategic efforts, when they occur, are on an ad hoc, responsive basis. In some organizations the materials management function has been elevated to the staff level with a vice presidential or directorship title. However, actual purchasing operations is still largely subservient to manufacturing. However, the staff function does provide for greater emphasis on procurement plans, corporate-wide contracts, and other strategic-related efforts.

As environmental changes in supply markets have emerged in the 1970s, this has had further impact on the procurement function. Serious problems have emerged through price escalation and the need for strategic responses for cost containment, materials nonavailability, lengthened lead-times, and problems in quality assurance irregularities. Forces influencing supply markets, such as cartels, political instability, and demands for offset and coproduction, have caused a need for quite drastic strategic changes in purchasing practices. Procedural skills are no longer adequate management approaches.

Procurement strategy has several different meanings to different people. To some it means strategy in source selection, negotiations, or in the construction and administration of requests for proposal or contracts. Strategy applies to using multiple sources to bid on or

supply the buyer's needs. However, all of these "strategies" are really just tactics for situations in buying. They usually lack long-range focus and often do not include various internal and external environmental factors which could be used to influence long-range plans concerning the buyer's relationship with supply markets and supplying institutions.

Long range strategy can influence everything from the stability and competitiveness of the supplier base used to management of risks through various degrees and forms of vertical integration. When an organization purchases, directly or indirectly, a substantial portion of its technologies, materials, components, or equipment from external sources, such a situation often has very critical and strategic impact upon the overall long-range success of that organization. However, when the procurement function is operating only in a situational, tactical mode and scope, such strategic criticality and influence often is only seen when crises arise.

High technology organizations often tend to have a relatively large share of their sourcing relationships with lower tier companies that are in "emerging" industries and/or "declining" industries where various sources of technological instability of financial/business shake-outs are occurring. Technological uncertainty, market uncertainty, high initial costs of entry, rapid cost decreases with global volumes, embryonic product spinoffs, and other factors can become strategic issues that are important in determining long-range source choices in a strategically oriented decision process. The extended procurement organization is often the important link to making such strategic assessment, but this only occurs when the need is recognized and a strategic management process is implemented.

The results of ineffective strategic management of the procurement function* can be one or more of the following:

*This refers to the function of procurement management in the extended procurement organization concept as opposed to the limited organizational definition of the purchasing or materials management department.

- (1) Inability or extreme difficulty in obtaining certain raw, semi-processed, or manufactured materials and components. There are difficulties in availability and access to suppliers.
- (2) Periods of rapid escalation in raw, semi-processed, and manufactured materials and components' costs.
- (3) Weak supply industry infrastructure at the lower tiers in supply channels, limited competition available, poor service, or limitations in skilled personnel and commitment to key specialized technologies.
- (4) Absence or limited product or technological standardization and excessive specialization and proliferation of parts, spares, and support requirements.
- (5) Strong perceived likelihood of product and technological obsolescence which leads to stagnation in innovation.
- (6) Erratic product quality assurance.
- (7) Problems in supplier image and credibility in the financial community and inability to expand to meet demand requirements.
- (8) Delays and problems in regulatory controls.
- (9) Inadequate motivation for furthering technological thresholds in product performance and manufacturing technologies.

These and several other difficulties are among the problems due to lacking strategic perspective and management of supplier relationships which were uncovered in previous research done by one of the authors in high technology companies. Responses to such problems often take the form of tactical, ad hoc problem solving, as opposed to anticipation, planning for, or taking of sufficient preventive action before the problems occurred.

Emerging Needs for the 1980s

Throughout many of the companies studied by the authors, materials management personnel have been "participating" in some strategic efforts. In program planning for specific DOD programs which the contractor managed, materials managers were sometimes heavily involved with program

managers to determine what materials would be needed and when--- materials requirements forecasting. However, when the question is put to materials managers "Will you be able to meet the four year operating plan?" the question from most was answered "If a problem comes up we will work on it."

One of the more comprehensive and detailed changes reflected in the role of procurement management for the 1980s involves the role of company-wide contracts. In one major electronics company, there was a proposed revision of the role of procurement for the 1980s based on what the company and its management consulting firm called, "Needs to Win in the 1980s." The corporate material services committee and procurement steering committee procurement plan for the 1980s identified the following needs:

- (1) Assurance of material availability at competitive prices
- (2) Vendor partnerships and closer relationships with mutual benefits.
- (3) Upgrading of the commodity group program and its purchasing strategies.
- (4) Materials acquisition from worldwide markets.
- (5) Improvement in technology interface with suppliers.
- (6) Improvement in management talent and training, planned expansion, and management supervision in purchasing.
- (7) Improved research of industry trends and resource market strategy data.

The thrust of these planning challenges came from scenarios and recommendations made by a consulting firm, but based on guidance and strategic thinking provided by senior procurement strategists. Data scenarios included reflected shortages of critical materials, a seller's market for many items, and the need for procurement pooling. A major organizational response was the creation of a corporate material services function, charged with research, environmental surveillance, and planning information. However, a major self-criticism still noted that the company was aimed too much toward tactical cost reduction and not enough on other more strategic issues.

A major concern voiced to the researchers by management focused on the company's critical dependency on ICs/microprocessors and other electronic components bought from the supply market. A study which had been done of this problem showed that whereas the total corporate dollar revenues would more than double over the next five years, and the percent of semiconductors used would increase by the same amount, the dollar value of semiconductors would increase nearly five times, even though the general cost of semiconductors industry-wide is decreasing. Purchases of semiconductors would increase from under \$200 million to nearly one billion dollars in the next five years.

Much of this analysis was the result of a changed role of procurement in the company and the use of an in-depth vendor and industry-base assessment. The company solicited several comments from vendors in critical areas and the following strategic issues emerged from this in-depth strategic study:

- (1) There had largely been a counterproductive overemphasis on price negotiations.
- (2) There was a lack of an on-going overall vendor relations program.
- (3) There was poor interactions with the company and vendors at high management levels.
- (4) There was poor forecasting of needs by customer organizations within the company.
- (5) The company was not adaptive to the seller's market due to management's short-term focus.
- (6) There had been a failure in supply market share planning for the future (percent of total supply industry volume the company would need and coordination of supply to fill demand).
- (7) Poor communications between purchasing and engineering on requirements and commitments .
- (8) No contract management effort in a long-term perspective.
- (9) Lacking uniform leadership in purchasing.

In addition, many elements of the pooled purchasing process that was on-going in the company were not effectively performed from a strategic perspective. These included mismanagement of issues and elements critical in a seller's market, improper clarification of divisional and corporate purchasing roles, and pool long-range planning. The company criticized its procurement planning specifically for:

- (1) Requirements and quantities generation over future periods was lacking, even though the company did long-range strategic market planning.
- (2) Research and market trends for resource supplies was poorly done.
- (3) Inadequate data were used in several key decisions.
- (4) There was no monitoring or revising of projections and forecasts that had been made of needs and supplies.
- (5) There was no development and use of purchasing business plans.

In several instances research indicated that the company purchasing personnel had not developed effective negotiation strategies relative to these long range issues.

Organizational changes proposed also reflected the recognition of the strategic significance of changes in supply industries. It was suggested in the internal study that the corporate materials services committee be expanded with specific divisional representation and residents at divisions with industry component specialists, including foreign purchasing. The mission of the corporate materials service committee was designated as:

- (1) Assign commodity group leadership
- (2) Establish procurement policy and guidelines for trends
- (3) Approve business strategy plans for commodity groups
- (4) Perform selected tasks by project teams in the following strategic issue areas:

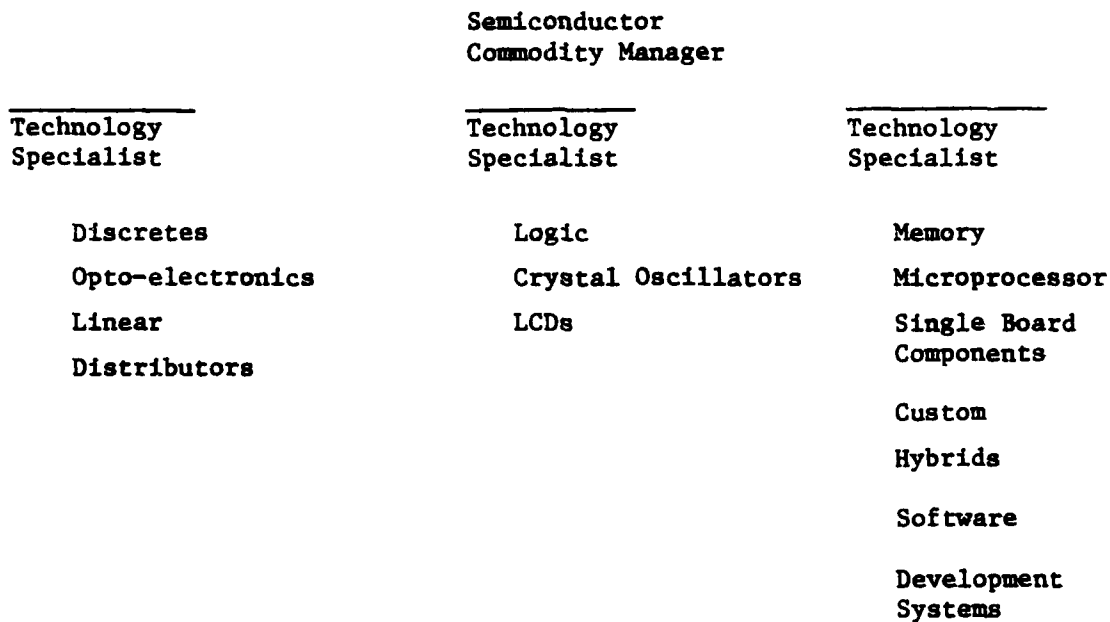
- (a) Training and manpower development programs
- (b) Improvement in supply market and resource forecasting
- (c) Offshore opportunities better defined
- (d) Use of corporate products and services coordination
- (e) Use of vendor qualification/end item product coordination
- (f) More use of standardization in items

The commodity group's responsibilities focused in particular on integrated circuits, connectors, capacitors, raw material business plans, and capital equipment as supply industries of strategic importance. Organizationally, operating divisions were assigned the responsibility of "host" division for management of the following areas:

- Electronic components other than connectors/capacitors
- Raw materials
- Wire and terminations
- Mechanical/manufacturing services
- Nonproduction, MRO items
- Special projects
- Semiconductors

These host division assignments were made largely on the basis of usage and expertise pertaining to the industries. These supply industry responsibilities were organized further into specific management task forces. One example is for the semiconductor industry, shown in Figure 39. This commodity group was assigned the responsibility for developing business plans--strategic long range plans--for the commodity, for developing trend analysis and for an information library. It was also charged to be the coordination point for interaction with functional groups in the company and outside consultants as well as for vendor partnerships. Planning effort for semiconductors was to include data collection, development of industry-strategic negotiation strategies, overall vendor interface plans, as well as tactical functions.

Semiconductor Strategic Commodity
Management Task Force Plan



Persons were procurement specialists in supply industry technologies and strategic supply industry issues.

Figure 39 : Organizational structure of a commodity group manager and management task force.

In companies that have the materials function review the strategic plans of businesses looking for materials issues, various relative successes were reported to the researchers. One organization had the materials manager at the division level review the strategic plans categorically looking for issues in the areas of raw materials needs and shortfalls, subcontracting capability needs and capacities, component volumes, and critical materials where availability might be in question. In some cases, many of which will be described in more detail in a later chapter, companies authorized and funded proactive efforts to protect the company from strategic resource deficiencies. One materials manager reported:

We made a long term strategic actions plan for materials, and on two DOD programs during FY 1979-80 we averaged over \$20 million in advance purchases of materials. This was paid for by our own funds, and we had no contract. If DOD had not come through with funding and approval for the program, we would have had 100 percent termination liability and would have lost the whole thing. The suppliers had no risk, since we were under contract to pay them. When you have provisions like "termination for convenience of the government," it is very risking in making your own advance purchases which later may be disallowed by some government contracting personnel.

In 1974 we started doing a market study of principal commodities, like aluminum sheet, plate, titanium sponge, sheet steel, castings, and so forth. We also did a supply and demand study for aluminum through the 1970s to examine capacity problems. It showed that demand would exceed supply in 1978 and to continue in a shortfall position well past 1981.

We brought in major suppliers, like ALCOA, to our plant and let them review our information. Sometimes we used a corporate purchasing agreement to buy a minimum capacity commitment, hoping that we would have enough flexibility within the company to use what we contracted for. In another case we did a joint venture with one of our suppliers underwriting part of the expense. We did that for doubling the capacity of supply for titanium sheet.

Some of the companies studied reported that they had made recommendations to the government through various Defense Science Board inquiries. Among the recommendations noted were:

- (1) Increase the up and down abnormal economics clauses in major subcontracts.
- (2) Develop tax incentives for investment.
- (3) Have greater rapid depreciation provisions.
- (4) Get away from one year defense contracts.
- (5) Get the aerospace industry to standardize parts like fasteners.

Another materials manager indicated that an important trend he saw was the ability of his company to sell suppliers on the credibility of the buyer's market forecasts so the supplier will invest capital to support the buyer. The manager indicated that this was particularly important since the up front costs for defense systems was becoming higher and higher, and the company had to use more subcontractor money to distribute the risk exposure. This had proven quite successful on commercial programs, but had been a very difficult task on military programs. Typically, suppliers take the market forecast of the buying organization, hire an independent consultant study of the market, and try to refute or corroborate the forecast. One manager made the following comment on his negotiation tactic with suppliers:

Often we have to sell our suppliers' boards. We have changed our pitch from risk share to revenue share. We are giving out packages of work for revenue share. If they contribute five percent of the program, they get five percent of the price on commercial programs. This includes program acquisition and potential spares. Under the share the revenue approach we expect share the investment necessary in resources--be they manufacturing, R&D or materials.

Leadtimes analysis of resource requirements has become a popular strategic issue in companies, although it is a rather passive approach. One manager noted that everything had to go through a discrete leadtime loading into a computer which was periodically updated. When lead times changed, the buyers entered this into the computer for the materials management information system. The manager commented:

Sometimes we have to go out and squeeze the leadtimes, based on our record as a good customer. Most of the suppliers reserve a certain portion of their capacity for our business. This capacity is reserved for what we call new development work. We try to negotiate no termination liability for it, since every dollar I have to pay outside, reduces what I can pay inside for preliminary engineering work. It comes out of the same budget.

This particular manager reported that in his particular viewpoint, his company had better prediction capability on winning contracts in the military business than in commercial. He indicated that the company faced larger volume swings from forecasts of commercial work in providing supplier assurances. This means that a program is usually "on or off" and if one wins the contract he is fairly assured of a specific quantity in military sales. It is more difficult to forecast such a sales quantity with accuracy in the commercial side.

The manager commented further to the researchers regarding strategic requirements planning efforts for materials:

On our production of parts for a current DOD program, we identify every piece and who will supply it for five years out, including lead times. We identify the potential constraints, such as materials availability. Each program has a materials plan for five years out based on forecasted DOD funding levels. If we see, say, a serious constraint in titanium, we go to work on that problem.

This has shown us that in 1981 we need to be able to spend long lead funds through 1983, and if we cannot get DOD to support that, we have to spend our own money. We are spending corporate dollars right now to protect lead times in several cases. If the program gets cancelled, we are out of luck. We can take this risk because we are very

sure of our program. However, it has had several major continuation debates in Congress. We are the only DOD source on the program and are not concerned about losing out to another supplier, merely losing to funding cuts. We are banking on our own forecasts and judgments about the security of the program in Congress and DOD.

Managerial Competencies for Planning

Traditionally, the materials management function has not had the stress on long-term strategic planning that it has in the past few years. Supplies markets have been more predictable and secure, the economy has been more sure, there have been less fundamental philosophic differences between the role of spending for defense versus domestic issues, and the magnitudes of dollars involved have been less. However, because of changes in resource environments, many procurement managers have been caught with insufficient perspective and skills in this area. In other cases, although the managers recognize the need and are willing to produce materials planning, their organizations have not recognized the need. Some of the managers interviewed indicated that it was a constant internal "battle" to push for a strategic role of materials management in their company management operations.

The Perfect 10

One materials manager interviewed, although his position was in a commercial products division of a large company and not a military products organization, indicated the following perspective about strategic thinking and planning competencies of his peers in industry.

You could rank the perspectives of purchasing managers from one (1) to ten (10). One is your common "garden variety" purchasing manager. Most of us fit into this category. We do the standard purchasing tasks called for by the NAPM (National Association of Purchasing Management). Many are certified CPMs (Certified Purchasing Managers). Our perspective is tactical and operational, and we react to problems as we see them to do what we can.

Few of us do much forecasting or real trend analysis that would qualify us for a two or three on the scale. We pretty much look at projecting from the past or merely react to data on past price increases or lead-times. Those of us that are fours and fives are doing materials requirements planning. We function with other departments to try to get a handle on what is required and then compare that with what we think will be available.

A six or seven will go out and give long term information to vendors and give them a chance to react to our long range needs. However, rarely do we see an eight or nine. He creates the future, he sees strategic challenges, he makes the vendors do what he wants by developing them with business strategies and long range plans. There are not many of these around and I am not sure that one has even been born yet. But their day has come, or heaven help our companies.

This materials manager went on to explain to the researchers a conceptual construct useful in strategic planning for procurement manager. The construct is an adaptation of the General Electric grid. It is shown in Figure 40. The horizontal axis represents a judgmental

		Criticality of Material to the User Organization		
		High	Medium	Low
Assessment of Capability of Resource Suppliers/Risks	Low	X	X	
	Medium	X		
	High			

Figure 40 : Criticality and capability assessment matrix for materials resources.

assessment of the criticality of a specific material to the user/buyer. More information about the assessment technique will be provided in a later chapter. The assessment assigns the material to a high, medium or low criticality classification. High criticality represents inability of the buyer to deliver the product to meet its performance requirements. Without the material, the product will not operate. There is no substitute. The vertical axis represents an assessment of the security and capability of the resource base or suppliers to provide the material over the time frame period of the analysis. Where uncertainties or difficulties are foreseen, the market is rated with a medium or low assessment classification.

Materials judged as highly critical are of particular interest. When these are also assessed with high risk for the resource supply, a strategic problem of materials issue is identified for managerial action. Medium categorization in either axis provides secondary level problems for management action. One of these assessment grids is developed for each materials required in the end product of for which a reasonable doubt exists as to the capability of the resource suppliers.

In examining the trends in materials management, one company materials manager made a differentiation between "strategic materials planning" and "materials strategic planning." He commented:

Many of us are doing strategic materials planning. That has become a quite common approach in the profession. We look ahead at what we will do about materials that are judged as strategic in terms of price or availability. But the problem is not merely with what are termed "strategic materials." The problem examines materials and technologies in general that are acquired from suppliers. Thus, we should have materials strategic planning-- or strategic planning for the materials management function. This should include such factors as long term vendor base development, manufacturing technologies of vendors, technological planning by key suppliers, and a host of other issues upon which we are dependent for supply. Merely looking at availability and price alone misses many of the key problems--although we have enough of those types to keep us busy.

We are doing strategic materials planning in this company. Materials strategic planning is quite new. We have done a study of potential impacts of various resource supply scenarios, and we are developing five year action plans to minimize the adverse effects and also to capitalize on opportunities.

Another corporate materials manager criticized the viewpoints and perspectives of personnel in his profession. He noted:

Most of us are just playing the game and are not materials managers for the major leagues. It is hard to get materials people to rise to the challenge. It happens intuitively on occasion, but not formally. Materials people need to expand their dimensions and recognize their critical, strategic role in the organization. The organization itself still perceives materials as largely an availability and cost reduction function. We use strategy of availability and strategy of cost, and react to manufacturing saying "go and get it." We need to put procurement and acquisition into the net income and profit equation more, not just the availability equation.

Finally, another materials manager at a divisional level commented about the relationship of procurement planning to strategic studies and the nature of ad hoc versus long-term efforts:

We have a report of what is going on in the marketplace of suppliers from which we generate actions, but it is not what you would call a plan. We have a procurement plan, but it is an annual reflection derived from the eight year window in our strategic planning. What the acquisitions are in terms of quantity, time phase, by product and suppliers, is what is contained in it. It is largely a manufacturing support plan.

Strategic actions are done on an ad hoc basis. We do not identify in a plan long term actions needed to assure the capability for supplying resource needs over a long term horizon.

However, our make or buy exhibit in a program plan is, in a sense, a strategic plan. It gets updated every year and we shift from annual procurement to advance funding. It is a strategic decision that reflects itself in the make or buy exhibit on a contract.

Normally when we see a problem of lead times we go to our customer, DOD, and ask to transfer the items from annual

procurement to advance funding.

Granted our planning tends to be ad hoc, since we never know if a supplier is going out of business or what a regulatory agency will do. But we have tried to get out in front of things to dampen the impact if possible. But it is still a situational, not a strategic, long range activity.

Factors in Procurement Planning

Examination of the factors in procurement planning mentioned in the survey by procurement/materials manager shows the following categories of planning factors: (1) financial/economic factors, (2) relationship factors, (3) functions of suppliers factors, and (4) general factors.

Financial/economic factors in procurement planning examine areas such as capacity expansion, financing of technological developments, investments for cost reduction and productivity for suppliers, and the willingness to undertake and distribute risk in product development. Cost issues tend to dominate this category, and the strategies of buyers focus on cost reduction and cost containment efforts.

Relationship factors pertain to the roles and expectations between the buying and selling parties. They include factors such as source base development and second sourcing, leader/follower strategy, gaining a wider, more responsive, more motivated supplier base, establishing more efficient operations of suppliers through incentives, writing better contracts and agreements, or improving the vigor and innovativeness of suppliers.

Functions of suppliers are quite similar to relationships, but pertain to the specific role which suppliers play--their required tasks. Such functions, which are often in conflict between the organizations, include the relative priority and efforts of suppliers to improve their productivity, improve materials control and quality, expand and relocate, or utilize new technologies.

General factors include all other issues not classified in the above three categories, such as personnel issues--maintaining high quality procurement managers, development strategic thinking of procurement managers, using more quantitative skills in planning, assuring more creativity and imagination in procurement management, developing information and research/trends analysis systems, and other internal issues to the buying organization's planning capabilities.

Several studies of planning in procurement have occurred over the past decade. A study done at the turn of the decade of the 1970s included some 85 strategically important factors which top management in a cross section of Fortune 500 companies were asked to rank. In the ranking of importance of organizational functions, procurement factors appeared in the lower half of all factors ranked in terms of strategic importance. Near the mid-point in rankings were issues such as "reduce materials cost, assure continuity of supply, and finding new material sources." Factors ranked near the bottom of importance were "improving inventory control, making products instead of buying them, and problems in subcontracting." Although a similar study has not yet been published showing perceptions in the 1980s, difficulties in locating lower tier capacities, specialty suppliers, controlling materials prices, and assuring materials availability, seem--from the interviews conducted by the researchers of this report--would probably receive higher rankings by top managements. At least this is the opinion of the materials managers.

Another study which focused on specific problems of materials shortages asked top managers to respond concerning the degree of responsibility of corporate and divisional/plant purchasing managers. The study was also conducted among Fortune 500 companies. Nearly half of the managers indicated that this responsibility of materials managers has increased in the past decade. Other more specific changes noted in the study included:

- (1) The establishment of materials strategy councils on a company-wide basis.
- (2) Increases in procurement staff's responsibilities in forecasting, materials strategies, and company-wide purchasing agreements.
- (3) Forty-two percent of the companies responding indicated that the purchasing executive was involved in the long range planning process.
- (4) Thirty three percent indicated that the chief procurement executive was involved in early stages of new product development.

Another study noted that eight key factors seemed to be very important indicators of the effective procurement relationship with major suppliers. These were:

- (1) Developing a past history as one of the supplier's major customers.
 - (2) Developing a past history as one of the supplier's best customers, in terms of prompt payment of invoices, avoidance of sharp bargaining practices, and close adherence to contract terms.
 - (3) Having an image of being a strong and dynamic, growing force with a future of prosperity.
 - (4) Keeping suppliers fully informed of long-range needs.
 - (5) Strong relationships between purchasing managers and sales representatives.
 - (6) Strong relationships between middle and top managements in both companies.
- (Emphasis added).

These factors suggest a trend toward longer-term, more stable supply relationships and less opportunistic source changes for the sake of tactical benefits, such as price decreases.

The procurement function can be hindered in its planning process if it is forced to adhere to near-term objectives and factors for performance measurement. There must be long-term emphasis in the function.

Summary

This chapter has introduced the concepts of planning in the procurement/materials management function. It introduced concepts of relative active and passive approaches to the procurement function with respect to the external resource environment, and developed the concept of the role of the extended procurement organization as the decision-making unit and managerial organization, not just the traditional formal purchasing function. It examined various perspectives in the charter and role of the procurement function in the extended procurement organization.

Emerging trends and needs of the 1980s, as perceived by some of the managers interviewed in this study, and from various research studies showed an increasing importance of strategic, proactive, entrepreneurial management perspectives on the part of procurement managers, and a need for increased use of long-range, strategic planning documents in the materials function.

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Chapter VIII

STRATEGIC MANAGEMENT OF RESOURCE MARKETS:

An Introduction

The purpose of this chapter is to introduce the concepts and procedures of strategic management of resource markets. This begins with an introduction of strategic thinking as it pertains to procurement and relationships with resource markets. Resource markets are defined and contrasted with consumption or sales markets. The chapter discusses competitive requirements with respect to resource requirements and source bases. It discusses planning with respect to resource market needs. The chapter concludes with the concept of strategic resource market planning and the major content of such plans.

Strategic Planning for Procurement

Any discussion of the role of planning in procurement must be rooted in the process of management of procurement. Strategic planning, on the other hand, is rooted in overall management operations and is basically an operating discipline, rather than a support or functional discipline as discussed in previous chapters. Nevertheless, wherein an organization is strategically dependent upon resources--material and technological--from suppliers, strategic thinking and planning becomes an important management issue in procurement.

The use and role of planning is rooted in the management culture of procurement, and in the competencies of procurement managers. The role of planning, thus, may vary from strictly tactical, operational planning to support manufacturing operations to strategic, entrepreneurial, proactive efforts to drive and develop supply and supplier relationships. If the charter of the procurement/materials organization and of the extended procurement organization is passive and merely involves adaptation to environmental problems, new techniques for innovative, proactive management will probably not develop. Even though the materials function operates under the customer-active-paradigm discussed in a previous chapter, it may not include proactive management beyond merely providing specifications and soliciting bids.

Fostering innovation and developmental change in the resource environment may be a key factor in high technology companies, but a passively chartered extended procurement organization is likely to be overly optimistic about the initiatives and capabilities of marketers in the supply environment.

The procurement process is basically a problem-solving process. However, it is the attitude and role of the manager in that process that determines the paradigm of initiatives. The procurement process involves the following objectives, only if management demands them in procurement's role:

- (1) Anticipation and recognition of needs and procurement opportunities and problems.
- (2) Determination of the characteristics of items and relationship actions needed to meet opportunities and problems with suppliers and their markets
- (3) Specification of what is sought well in advance to allow suppliers to strategically plan for and develop requirements
- (4) Not only searching for, but developing sources and source bases for material and technological resources.

Such an approach is not mere adaptive management, but developmental management. Just as can be the case in overall strategic planning, procurement planning can be adaptive or developmental along a continuum of orientation. Strategic planning in the procurement function involves a developmental, entrepreneurial, proactive approach. It involves analysis of resource supply environments and long-range perspectives, development of long range objectives, and development and implementation of strategies. Contingencies must be identified and planned for with appropriate trigger points.

Among the most complex of strategic problems in materials management are those associated with supplier relationships and motivational incentives. Strategic planning decisions concerning supplier relationships include the following:

Some Strategic Factors in the Procurement Planning Process

General Factors

Attracting and maintaining a high quality procurement management force

Developing managers for future strategic challenges

Developing better procurement organization

Using more quantitative decision tools and computers

Assuring better creativity, imagination and entrepreneurial skills

Perceiving trends and challenges in emerging resource markets

Motivating, encouraging and rewarding proactive efforts

Relationship Factors

Accumulating a better knowledge about resource markets and suppliers

Establishing a wider or more competitive source base

Establishing more selective and deeper source base capabilities

Establishing more efficient product delivery systems/logistics

Writing better proposals and contracts

Improving relationships with suppliers

Producing more vigor and innovativeness in relationships

Financial Factors

Gaining financing within the resource market for expansion

Gaining investment for improved manufacturing technologies

Gaining financing for R&D effort

Improving willingness of lower tier suppliers to take risks commensurate with returns.

Applying ROI criteria to resource market incremental investments.

Functions of Suppliers

Obtaining more efficient product manufacturing methods

Improving plant operations

Improving quality capabilities

Improving in-house product engineering

Relocations as necessary

Improving results of R&D expenditures

Increased foreign production and offset

Improved technological state of the art

Figure 41: Some strategic factors in procurement planning

- (1) Acquisition and disposition of a supplier's facilities (backward integration).
- (2) New products developed by or jointly with suppliers
- (3) New channels of supply and source bases
- (4) Redesigning an organization structure to accommodate problems in strategic relations with suppliers (extended procurement organization, procurement councils)
- (5) Determining the extent and role of corporate-wide acquisition agreements versus decentralized authority
- (6) New technology investments and influencing R&D investments of suppliers.
- (7) Distribution of risk and termination liability.

These are but a few examples of strategic decisions in procurement.

In order to provide a strategic basis for decision-making, procurement management planning should involve:

- (1) Information from environmental surveillance and analysis
- (2) Forecasting and making strategic contingency assumptions regarding environmental factors for the future
- (3) Determining and redetermining missions and objectives with respect to markets supplying resources
- (4) Selection of strategic actions
- (5) Developing and implementing action programs and projects for strategic objectives.

Figure 41 illustrates a few of the strategic factors involved in planning for the procurement function. They have been classified by the authors into general factors, relationship factors, financial factors, and functions of suppliers factors. Each factor can become a strategic issue in procurement planning.

Confronted with a seemingly endless stream of day-to-day problems, and often unfamiliar with the terminology and procedures of strategic planning, many procurement managers indicated that they viewed such objectives as "like to have" or "that's the way we should be doing it," but indicated but relatively little of this type of planning is occurring. However, many also indicated that upwards of 60 percent of sales dollars were represented in outside purchases, and the need for strategically

managing this expenditure process should be just as important as the strategic management of the marketing/sales process.

Approaches to Strategic Planning

Planning within the procurement functions studied by the researchers took on various shades of strategy and tactics. Perhaps the most pronounced strategy comes when a company is faced with severe price increases or inadequate deliveries of materials from limited source environments. Effective strategy in negotiation and in contracting methods can spell the difference between success and disaster in these types of environmental relationships. However, in negotiation and contracting the approach is reactive, adaptive and not proactive and developmental. Some creative problem solving might occur, but it is in response to a problem which comes up, and usually on an ad hoc basis.

Strategic planning is more than what one materials manager termed "working the problem." It is more than forecasting and evaluating trends. Suppliers can play an important competitive role in product design efforts and new technology efforts, and can be very important when their customer expands market development or builds production facilities at a new location. Supplier technical know-how can be a competitive edge.

New product development often requires engineering development which transcends organizational boundaries in high technology organizations such as those in the aerospace industry. It may involve technological teaming or other methods of assistance. However, planning by procurement organizations, in most cases, has not included such technological teaming and long range technology efforts beyond the immediate programs and projects. What planning that does occur, happens informally between engineering personnel and suppliers, often with embarrassments as to commitments. Rarely is there a management decision to influence key technological and product decisions of suppliers with an attempt to shift the risk to suppliers.

Typically procurement managers operate in an ad hoc manner, with written memoranda and papers which are not consolidated nor reviewed

as comprehensive procurement plans. Many materials managers, when asked by the researchers to provide evidence of procurement planning, showed scheduling charts, milestones, and operational planning data. Narrative, strategically analytical reports for long-range impact were almost impossible to find. Often, even though very strategic actions were occurring with suppliers, these were managed in a day-to-day manner, without formal strategy plans and reports.

Strategic planning can be a vehicle for educating procurement managers in planning and thinking strategically about issues and decisions. However, in nearly all of the companies studied there was no formal attempt to develop such skills in procurement managers. Efforts were focused on line/program managers. Most functional managers, especially procurement managers, were involved only superficially in strategic planning. This involvement is confined usually to the top corporate or divisional procurement officer who reviews strategic plans for "procurement implications" --basically material requirements planning over a one-two year time horizon.

When, for example, a Department of Defense contractor becomes involved in developing technologies and prototypes of, say, a new space vehicle, there are many lower tier organizations involved in the development process. However, long-range planning for such lower tier involvement is done very informally, if at all, and is normally under the jurisdiction of engineering personnel.

Strategic planning in the procurement function should transcend individual contracts, programs and projects and should encompass the entire business plans of the organization and the supportive role which suppliers must play. It involves identifying broad mission requirements for suppliers over an extended time horizon and analyzing the future capabilities and potential shortfalls of suppliers. This is particularly true in high technology industries, where time horizons are very long in state-of-the-art development cycles.

A working definition of strategic planning for the procurement function was developed by the authors to be used in the remainder of this report:

The process of deciding on the physical and technological resource needs over an extended time horizon, and developing relationships with sources for supplying these needs within the lower tiers of the industrial base through identifying strategic mission requirements, objectives, goals, and capabilities of supplier markets and individual source mixes in a creative, proactive manner.

Relationship with the Procurement Process

An important element influencing the nature, style, and content of strategic planning for procurement is the procurement process and organization which the company uses. This process--largely centered in the formal procurement organization--involves eight basic steps or areas of responsibility, which are:

- (1) Providing supplier market information for analysis
- (2) Identifying supplier market requirements--material, technological, and manufacturing.
- (3) Identifying, soliciting, and encouraging sources to compete for business.
- (4) Selecting and contracting with sources
- (5) Internal relations with other departments which influence procurement decisions directly and indirectly.
- (6) Financing and making financial arrangements for purchases
- (7) Storing, receiving and other materials management functions
- (8) Risk identification and distribution in the acquisition process.

The formal procurement organization, largely at the division or plant level, is involved in such steps and should have primary responsibility for them. Planning attempts to link in a practical way the resource-based

technical function of procurement and contracting with the principles of management by objectives and strategic planning. Planning attempts to put an end to the intuitive approach to decision-making and may even transform the procurement organization style from adaptive to developmental.

Planning within the procurement function provides a discipline in committing intentions to a written long-range document. However, often managers object to such discipline as an "operational strait-jacket" with little flexibility or opportunism. However, in reality it is a search for logical goals and ways to achieve the resource needs of the organization under a variety of issues, assumptions, and opportunities. It has no intention of providing inflexibility, but just the reverse--improved flexibility through long-range thinking. It should enhance the organization's capability and flexibility to respond, not detract from it.

Organizational Demands

The locus of buying activities hinges largely on two aspects of supplier/customer relations. First, the nature of engineering involvement with the supplier, as discussed earlier, is one of the key, critically important functions in a high technology organization. Second, manufacturing has a key role in that in most instances internal manufacture is an option for both technology and production.

Where there is relatively heavy engineering involvement with sources in design and development and/or in continued engineering monitoring of design changes and quality, the buying organization should serve in a coordinative role for both execution of this action and in planning it. Engineering and manufacturing personnel may become deeply involved in resource and supplier decisions, especially in early stages of product and technology development cycles. Engineering involvement is also intense where the design of a subsystem or purchased component is evolving technologically. In such cases, it is essential that purchasing have a close organizational involvement over this process both tactically and strategically.

The multifunctional spreading and abstract responsibilities in working with sources can provide numerous management problems in the short run, not to mention the long run. Consequently, strategic planning by the procurement organization should involve continual long-range thinking interactions with other internal functions with regard to resource needs, supplier long-range capabilities, and planned strategic actions. Initiatives, both adaptive and proactive in nature, come from engineering, manufacturing, and even sales organizations. Thus, a strategic plan for the procurement function is not a single department entity, but involves multiple department coordination and development, with the locus of responsibility centered in the procurement function.

One of the principal organizational demands of strategic planning is the proper planning culture. Strategic planning should occur in an environment which not only allows, but fosters a degree of relative fanaticism and accepted of the seeming "chaos" that is involved when creative skills are applied. Yet, the culture must also be disciplined and rigorously analytical in defending ideas and solutions to problems. When short term objectives become too important, such as materials deliveries, cost increases, and contracting issues, the procurement function must have the organizational capability to handle these tactical problems, yet still work rigorously on strategic perspectives and problems. Such a culture demands recognition and support from top management.

Procurement organization styles, if rated on a scale of one to ten, ran the spectrum from routine traditional order-placing, expediting, and order-processing in some companies studied to dynamic, proactive and customer-active initiatives which were aimed at driving resource capabilities to meet the buyer's needs. On this scale, the majority of DOD contractors were found to be in the 3-4 range, with only one or two even emerging toward the 8-9 range.

Studies of Procurement Planning

Several studies of procurement planning and planning issues in overall corporate/divisional strategic plans have occurred over the past decade. A study done at the turn of the 1970s included some 85 strategically important factors to overall management in a cross-section of industries. Managers in top level positions were asked to rank the relative importance

and priorities of procurement factors as compared with other factors in company/divisional management. Procurement factors were ranked near the middle of the overall listing. Another study of strategic responses to specific material shortages among several Fortune 500 companies showed that the degree of responsibility of corporate and divisional procurement executives had increased over the past decade. Many companies have given the procurement executives vice presidential or directorship titles, have organized materials strategy councils within and/or across divisions, and perform ad hoc studies of specific materials problems. The study, however, made no mention of the role of procurement in strategic planning.

Many companies have enlarged their purchasing staffs during the 1970s and the corporate procurement officer has membership on several key top management committees. Forty-two percent of the companies surveyed in another study included the corporate procurement executive in long-range planning, and thirty-three percent have the person involved in new product development activities from the start. One study showed eight key factors which procurement managers have adopted as part of their strategic relationship with suppliers. These are:

- (1) Developing a past history as one of the supplier's major customers.
- (2) Developing a past history as one of a supplier's best customers in terms of prompt payment, avoidance of sharp bargaining practices, and close adherence to contract terms.
- (3) Having an image of a strong future for growth and prosperity as a customer.
- (4) Managing dependence on suppliers in single source relationships.
- (5) Keeping suppliers fully informed of long-range needs.
- (6) Strong relationships between purchasing managers and sales representatives of the suppliers.
- (7) Strong relationships between middle/top managements of the companies involved.

This study shows several key issues of strategic importance being recognized within the role of the procurement function concerning relationships with suppliers.

Procurement planning is more than merely forecasting supply and demand problems. As one author put it, it calls for:

Selection of profit-sensitive and critical commodities. It requires that purchasing formulate specific annual cost and service objectives in a written plan. Buying strategies needed to achieve these objectives are rigorously spelled out. In other words, it aims at developing comprehensive sourcing strategies .

Several authors have criticized management of a myopic view of their own role. Perhaps most notable has been marketing. History records the problems of companies who have failed to define their markets and product lines broadly enough and have lost when demands changed. This is also true of procurement. Failure to define the requirements in a broad sense can cause failure to recognize comprehensive issues such as impending competition from rivalry industries who may begin to use common resources. Current difficulties in the acquisition of aluminum, for example, stems in part from the large increase in use by the beverage industry.

Strategic Issues in Procurement Planning

Typically, what does the materials function at the corporate or divisional level practice in the way of planning? Answers provided to the authors normally indicated the following tasks:

- (1) Quarterly (or less often) materials forecasts, often by part number, on the basis of projected sales for a year.
- (2) Budgets and targets for the upcoming year.
- (3) Programs for standardization of items.
- (4) Corporate purchasing agreements.
- (5) Lead time forecasts received from suppliers.
- (6) Material price/cost forecasts received from suppliers.

- (7) Computerized systems support
- (8) Make or buy analyses
- (9) In a few instances, long-term (2-3 year) contracting with option agreements or blanket orders. Some systems contracting was also noted.

As can be seen from this lists, there are trappings of strategic, entrepreneurial actions in striving for standardization, in using corporate agreements, and in obtaining long term forecasts from suppliers. However, there is a lack of external, proactive initiative in this listing, and the focus is much too short for adequate advance planning for responses, much less developmental efforts, concerning supply market problems.

Several companies supplemented lists such as this with long lead funding provided to suppliers and advance procurement authorizations. A few included some alternate source development plans, although the majority of this effort occurs through trying to interest other sources in future business, rather than joint ventures, joint funding, or joint technology development where necessary.

The system of forecasting costs at a part number level varied between companies, particularly with respect to the taking of specific actions to achieve target costs. Forecasting occurs prior to material requirements and requisition cycles, and in many cases involves attempts to gain advance knowledge about cost problems, lead times, sourcing problems, and availability of materials. Such advance knowledge could lead to suggestions to change materials, buy ahead, recompute, and other tactical responses to problems. One company provided an example shown in Figure 42 for recording quantitative procurement accomplishments. The company management submitted this as an example of strategic action. Although several of the actions in this report, such as small, disadvantaged business awards, might take effort that goes beyond one year, the orientation is toward making awards to these businesses, rather than affirmative and entrepreneurial actions to develop prospective sources technologically, financially, or managerially.

Annual Quantitative Accomplishments/Goals

Direct Indirect Non-Regular Total

Workforce

Ceiling
Actual

Purchase Payments
(\$ millions)

Plan
Actual

Small Disadvantaged
Business Purchase
Payments (\$ millions)

Plan
Actual

Burden Rates

Plan
Actual

Overhead Expense
(\$ millions)

Plan
Actual

Regular Special Non-Burdened Total

Regular Special

Figure 42: Annual quantitative accomplishments/goals plan

The following comments reflected the sentiments of one materials manager regarding what he considered as his strategic role:

For the past couple of years, procurement has been heavily involved in strategic planning with lots of emphasis on saying what the market is for the future and what our plans are to deal with that. The emphasis is on how we will get from A to B in our resource needs. However, this is a function of having more easy and direct access to the president of the company. The outside relationships job involves higher management, whereas the inside role (of procurement) involves assisting the group where subcontracting and manufacturing issues are involved.

The major issues in which we have been involved strategically, have been critical materials--their availability and cost. We have also looked at offsets and coproduction. However, we have been reactionary here and are not sophisticated. We have no long term strategies for make or buy. The overriding considerations in the strategy sessions for the past two years have been on getting critical materials.

The manager also indicated that for several years materials availability had not been a key concern. The company relied on foundry suppliers and materials suppliers as adequate sources. He indicated that this had changed, and in management meetings personnel were beginning to ask questions such as "Where does our cobalt come from initially?" This has led to the development of purchasing strategies for specific critical materials.

Another important issue expressed by this manager concerned global manufacturing planning and offsets. He commented:

So far we have not done much planning. We have merely done ad hoc studies. Now we are in a new program to review and assess our global relationships with suppliers. We are developing a group level strategy for subcontract manufacture and we are including issues of critical materials, offset, and coproduction into these long range plans.

One of our concerns is mainland China. How to develop it as a resource market. A main interest is in potential offsets. The manufacturing strategic plan has procurement sections in it discussing the role of mainland China as a materials and assembly source. It involves working on supplier capabilities and availability of materials.

The firms studied varied with respect to their attitudes toward the role of procurement projecting itself aggressively in the supply market. Some managers felt that the tactical, operational view was very capable of handling, in a reactionary fashion, problems coming from resource suppliers. Whether or not this is true, they felt no specific concern for doing more strategic planning and proactive efforts. However, other materials managers took a very opposite view, as shown here in the statement of one at a divisional level:

We do not allow the abandonment of vendors lightly. We will switch sources only with a strong provocation, and consider our source relationships as part of our long range business capabilities and strategies. Engineers and production people are made aware of this. We also do not permit engineers to have direct contact with new suppliers which may jeopardize our existing source relations. This must be carefully coordinated through procurement. There is some backdoor selling by suppliers, but initiatives from vendors are controlled to go through purchasing, especially if there is a possibility of a commitment being made. This is an aggressive internal and external role of purchasing, and often engineers do not like it, but it is the way we operate here.

Among the strategic issues mentioned by materials managers in the companies studied in this report were the following:

- * Shortages of materials
- * Lengthened lead times
- * Problems in procurement manpower, volumes increasing¹
- * Inflation in costs
- * Regulation
- * Inventory investment and turnover
- * International programs (offsets and coproduction)

In addition, many managers saw the relative percentage of purchasing to sales increasing over the past five years and continuing to do so over the next

¹Particularly true in companies attempting to source more outside to spread the upfront or termination risk on programs.

five. In most cases, the relative amount of purchasing to sales was nearly fifty percent. In some companies it ran as high as seventy-five percent of sales. The low percentage reported was thirty-five percent.

One manager stressed to the authors that he thought the materials management profession should stress the understanding of differences between strategic materials planning and materials strategic planning. He commented:

Many of us are doing strategic materials planning as a key issue. We are trying to look ahead at what will be the case for materials which we consider strategic in terms of price and availability. The problem is not merely with strategic materials, however. It is with materials in general. Thus, we should have materials strategic planning or strategic planning for all materials and not just portions of them. Other strategic issues should also be included, such as vendor base development, vendor manufacturing technologies, technological planning by vendors, and a whole gamut of long-range issues relative to our dependencies and needs from suppliers.

But the focus of most materials managers is on supplying materials to manufacturing, operating capabilities, not on long range business direction and planning.

Another manager contrasted the approach of materials management to the ability of baseball players in major versus minor leagues. He noted:

Most of us are just playing the game and are not really ready for the major leagues. It is hard to get materials people to rise to that level. It happens intuitively to some people, but it is not done formally. Materials people are in need to expand their dimensions and recognize the strategic, critical role they play. The organization itself perceives materials in a tactical way. We use strategies of availability and strategies of cost, in a reactive way. We need to put procurement and acquisition into the net income and profit equation for the long term.

Finally, another materials manager made the following points in his assessment of the operation of the materials function in industry.

We have a report of what is going on in the marketplace of suppliers and we generate actions from this. But it is not what I would call a plan. We have a procurement plan, but

it is merely an annual reflection of an eight year window in our strategic planning. The strategic plan is for eight years, but the material/procurement portion is one maybe two years in cycle. It is largely a manufacturing support plan.

Any strategic problem identified is handled on an ad hoc basis. We do what I have called market research in our company, and I examine our supplier markets and publish a report.

Our make or buy exhibit in the program plan is, in a sense, a strategic plan. It gets updated each year and we shift from annual procurement to advance funding for bought items where problems occur. But materials plans are made to support program plans, and not for the relationships with suppliers in general.

Summary

High technology organizations tend to have a relatively large share of their requirements supplied from lower tier, supplier organizations. The competition time horizon in these industries is usually quite long, due to the long development cycles for technologies and high technology programs. Yet the view of strategic dependency on suppliers for materials and technologies is only short range, and ad hoc in style. High technology companies are often dependent on emerging or declining industries as technology cycles change, yet this is seldom reflected in strategic plans. The dependency on such suppliers is managed informally, largely by engineering organizations.

The results of ineffective strategic management of the procurement function can cause many serious problems for the buyer, among these are:

- (1) Inability or extreme difficulty in obtaining certain raw, semiprocessed, or manufactured components and materials. Difficulties in availability and access to supplies.
- (2) Periods of rapid escalation in prices of such items.

- (3) Weak supply industry infrastructures and economic bases among lower tier companies in production, distribution, and skilled/trained employees and personnel.
- (4) Absence or limited product or technological standardization and excessive specialization and proliferation of parts, spares and support requirements.
- (5) Strong perceived likelihood of product and technological obsolescence which leads to stagnation in innovation.
- (6) Erratic product quality assurance.
- (7) Problems in supplier image and credibility in the financial and manufacturing communities.
- (8) Delays and problems caused by inadequate responses to regulatory controls.
- (9) Inadequate motivation for furthering technological thresholds in product performance and manufacturing technology.

These problems become particularly acute in the dynamics of high technology aerospace industries. Responses to such problems can be handled in a variety of ways. However, the focus of this study is upon strategic planning as a tool to improve the capability of the materials function to manage such problems in supplier relationships. The next few chapters will discuss specific examples, in detail, about approaches used by aerospace companies.

References

Same as Chapter VII

Chapter IX

STRATEGIC MANAGEMENT OF RESOURCE MARKETS

This chapter introduces the concept of resource markets as a differing perspective from examining specific suppliers. It presents the dynamics of resource markets and the role of strategic planning in managing resource market relationships. It also begins an overview of the process and steps of strategic resource market planning.

Resource Markets and Sources

The operational and strategic perspectives of procurement can be distinguished by the view of suppliers held by management. In the operational setting, buyers view their business relationships with suppliers--specific institutional entities. In strategic management they view their relationships with resource markets, which also includes institutional suppliers. Just what are resource markets and why is this perspective important to strategic planning?

A materials market consists of the global industry capable of supplying a specific commodity or material--such as the aluminum industry, or the steel industry. Taken together, where aluminum or steel might be used, the two industries are competitive and, consequently, are a resource market. The buyer refrains from committing to a specific resource, but sees competing resources as part of a broader perspective. Technologically this is also an important distinction. A buyer may see a specific technology as the required solution to a problem or he may see multiple competing technologies as possible solutions. The latter view examines technological resource markets.

The Department of Defense has made a major move toward viewing the industry base as a resource market with the publication by the Office of Federal Procurement Policy of OMB Circular A-109. This document provides procedures whereby acquisition must occur through a resource market approach. The decision on committing to one technical solution to a need is postponed long into the acquisition cycle to allow for multiple competing approaches and technologies.

Resource markets are made up of multiple supplier industries or supplier bases. An acquisition strategy might call for a specific supplier or source base comprised of a specific group of firms in one of the industries making up the resource market. Thus, if a company decided to source its steel from U.S. Steel, Ryerson, and Bethlehem Steel Company, this would comprise its source base. The source base would be these three firms within the steel industry. The steel industry would be one industry within the metals resource market.

Examining supply markets as resource markets, instead of specific industries, allows the buyer flexibility in choosing the best materials solutions among competing materials. However, it also has a broader benefit. It allows the buyer to examine other competitive buyers of resources--companies in other industries who are also sourcing in a resource market context. The beverage industry, which had traditionally sourced containers from steel producers, switched and sourced from the aluminum industry. In so doing, the beverage industry became a competitor of the aerospace industry for the services of the aluminum industry. A broad, strategic resource market focus allows the buyer to examine both several competing and potentially competing supply industries, as well as several competing and potentially competing demand industries.

Dynamic Management of Resource Markets

Figure 43 illustrates the external environmental appraisal requirements in strategic planning, including resource markets. Often such environmental appraisals look merely at sales and customer opportunities. Figure 44 illustrates the multi-tier nature of resource markets--a vertical aspect of such markets--in the aerospace industry. Figure 45 shows horizontal competing industries within resource markets.

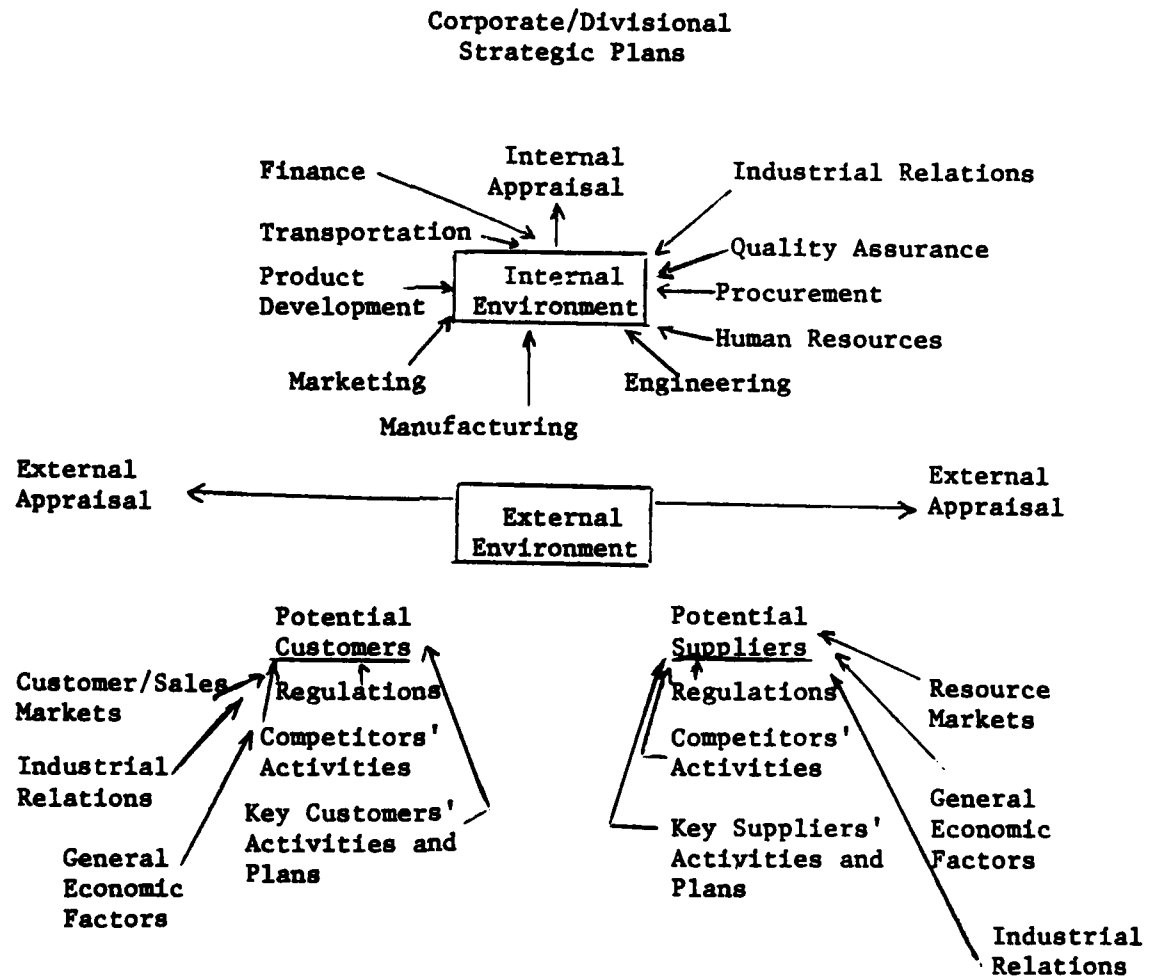


Figure 43 : Environmental appraisal in strategic planning for customer/sales markets and supplier/resource markets.

In the above figure, the same basic factors which are involved in environmental appraisal for sales/customer markets--as discussed in previous chapters--should also be applied in performing environmental appraisal of supplier/resource markets in order to provide for effective strategic planning for the supply of resources.

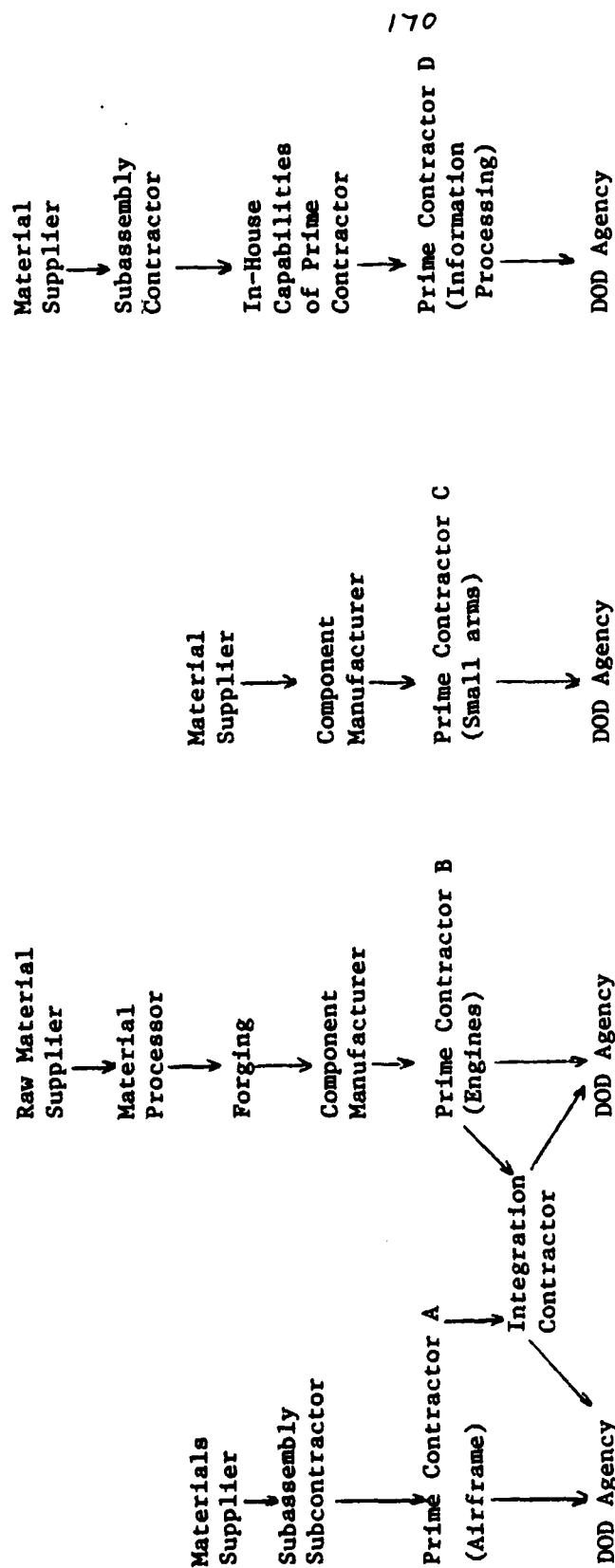


Figure 44 : Multi-tier relationships in resource supply environments in the aerospace industries

In figure 44, this oversimplified diagram shows examples of various multi-tier relationships as experienced in DOD acquisitions. In the production of aircraft, for example, raw materials and processed materials are part of the resource market environment, even though they flow through processing and subassembly manufacturers, who are the subcontractors of the major component producers. Strategic planning done by, say, the integration contractor, should include planning at all levels of the multi-tier resource flow process. That is, it should focus on the dynamics and strategic issues influencing industries at all levels in the supply channel.

In the case of airframes, the example shows the supply of materials, such as aluminum, coming to a subassembly subcontractor--perhaps a company producing fuselages--and then to the prime contractor for the airframe. For engines, a raw material, such as titanium mining, comes to the prime contractor for some components produced in house or may also come to a material processor who puts it into ingots for a forging. A component manufacturer produces an item used in the engine. The final flow comes to the engine supplier, then to the integration contractor who installs the engine on the airframe (most likely the airframe supplier).

In the third example, a straight materials supply from one tier to another is occurring, while in the fourth example, in-house capabilities are providing many of the components needed in an information processing system, and the prime contractor is supplying some items--perhaps Government Furnished Equipment (GFE) or Contractor Furnished Equipment (CFE) to subcontractor efforts. In all of these cases, the final flow comes to a DOD agency. Thus it is important that DOD agencies also do strategic resource market planning to examine their areas of vulnerability and strategic problems in supply/resource markets.

Resource Markets

Lower Tier Materials

Steel Industry
Aluminum Industry
Titanium Industry

Upper Tier Manufacturers

Airframe Fabricators
Missile Fabricators
Appliance Fabricators

Sales/Customer Markets

Defense Industry

Naval Air Systems Command
National Aeronautics and
Space Administration

Commercial Aircraft Industry

Airlines (Passengers)

Air Cargo

Refrigerator Buyers

Figure 45 : Levels of competition in resource and sales/customer markets

In figure 45 sales/customer markets involve competition within segments of customer industries and between industries. Naval Air Systems Command competes with other DOD agencies for acquisition budget allocations. It also competes within overall governmental budgets with the National Aeronautics and Space Administration, since dollars spent, say, on Space Shuttle, cannot be used to buy more F-18's. NAVAIR also competes with other agencies for governmental funding.

However, the key factor in this figure is the fact that all the sales/customer industries and agencies compete with each other for the resources listed in the first column. Upper tier manufacturers in the resource market of the defense industrial base compete with each other for resources to support, say, a NAVAIR program. According to OMB Circular A-109, NAVAIR should encourage competition between, say, an airframe fabricator and a missile fabricator regarding the best technical solution to a mission need. However, when it comes to competing within the lower tiers for resources, both the airframe fabricator and the missile fabricator compete for, say, steel and aluminum. They also compete with the appliance industry, for, say steel.

As a result of this situation, NAVAIR is actually in competition with both the commercial airlines, air cargo, and refrigerator buyers for the same lower tier materials resources. This aspect of strategic planning--horizontal competitors for the same resources--is often a key part of success in acquiring needed defense systems. Excessive use by, say, the beverage industry of aluminum smelting, or, say, the commercial airlines of, say, large forging capacity, actually can cause delivery problems for NAVAIR weapons systems.

Resource markets are dynamic and are shaped by the activities of suppliers, potential suppliers, and the initiatives and plans of competitors at various levels in various industries. Environmental analysis of resource market dynamics over an extended time horizon, thus, should be a key responsibility in procurement planning. Whereas traditionally procurement focuses on tactical, operating decisions, it should include:

- (1) Understanding and forecasting long term resource needs
- (2) Developing long range requirements forecasts for materials, products, technologies, and supplier capabilities
- (3) Active, entrepreneurial seeking of new sources, source development and competitive activities to enhance the buyer's position in the resource market relationships vis a vis competitive buyers
- (4) Challenge specifications and provide analysis of substitute materials.

Various factors cause dynamic change in resource markets. Industries themselves are dynamic in nature, go through development cycles for institutions as well as for products and technologies. Take, for an example, the semiconductor industry. It began when semiconductors were first introduced in applications where end products needed miniaturization and heat reduction--such as transportable radios. The industry developed through the development of additional end-use applications and through cost reductions via global marketing strategies and experience curves.

Resource markets move through various stages of development as new firms enter and others exit or specialize, as product options proliferate or contract, as prices change, and as increased differentiation occurs. It is important that the reader understand the difference between a vendor industry and a resource market to fully appreciate this dynamic process. A vendor industry, such as steel, aluminum, or titanium pertains to a specific generic product and various forms of that product. A resource market, on the other hand, knows no generic product of technological boundaries. If the resource under issue is a material, it relates to specific properties and capabilities sought by the buyer. Consequently, a resource market is buyer defined. The boundaries of the market are only determined by the imagination and innovativeness of the buyer. A-109, for example, is basically an attempt to get acquisition managers to broaden their perspectives of resource markets to competing alternative technical solutions and perhaps even different modes of basing a system--sea, air, space. Myopic views of specific resource vendor industries provide limitations to the approaches that can be taken in solving resource problems, strategically.

Competitive buyers of the output of resource markets must also remove myopic perspectives toward user industries. Aerospace firms compete with appliance manufacturers, as in the above example. They also compete with medical schools and law schools for human resources in competition with engineering.

The dynamics of specific industries and across broad resource markets come from many events outside the industries themselves. These include new developments in technologies--such as in extraction equipment--or political changes in governments of countries possessing the resources, or in changes in regulations such as the Environmental Protection Agency (EPA). These factors can have strategic influence on the capability and viability of various industries and firms in resource markets, and should be part of the strategic planning process.

Resource Market Factors in Strategic Plans

The degree of volatility of a particular resource market is an important stimulating factor toward the need for greater emphasis and awareness toward this aspect of strategic management. Following the increases in the prices of materials, organizations often resort to corporate-wide purchases to gain a better position or some other reaction. This can be effective, but may still require the payment of a high price. Effective resource market forecasting and planning can provide time for management to consider other alternative actions. Furthermore, even corporate purchasing often requires adjustments between divisions and plants to adapt to standardized components to be bought under the agreement. Time becomes an important ingredient in this strategy.

The growing awareness of the need to include resource markets and market relationships in formal plans was expressed by several of the materials managers interviewed in this study. The growing need to include procurement issues in organizational planning effort was manifested in several ways, such as:

- (1) A greater recognition of the importance of resource market dependencies in new product/program development.
- (2) Although only one quarter of the companies surveyed in the 1970s indicated that company-wide procurement organizations were operating, all respondents studied either had this in operation or were planning on it within the next two-three years.
- (3) Corporate and divisional officers review strategic plans for implications and issues.

However, in not one instance did the researchers find any formal or even informal environmental analysis and interactive study of competition in resource markets. Materials managers, for the most part, place themselves in the position of being passive recipients of whatever the market provides them.

The main purpose of strategic planning concerning resource markets is to pinpoint key issues and considerations, current and emerging or potentially emerging, upon which strategic objectives and actions can be built. This process requires an examination and preparation of well-prepared information bases. Thus, resource market planning requires (1) strategies of information, (2) strategies of direction and purposes, and (3) strategies of action.

Strategies of information come from the environmental analysis mentioned earlier. They have two important uses: diagnosis of strategic problems and decision-making for strategic direction. Information concerning resource market competitive environments, internal organization needs, and requirements for development of resource market capabilities constitute three important information categories. Specific information objectives vary by company and industry, but might include:

- (1) Key leverage points for increasing profitability and competitive advantage through acquired resources.
- (2) Resource market growth rates and opportunities.
- (3) Nature of the supply market competitive environment, capacity utilization, price trends, number and size of competitors, and integration changes.
- (4) Trends in manufacturing technology, potential process breakthroughs, research and development efforts within lower tiers, and important management changes.

Objectives which flow from strategic planning for resource markets also vary, but might include the following which was provided by a materials manager in an aerospace company:

When I think of long-range planning for my function, it is a process of deciding on the procurement relationship objectives and processes of our entire division organization to lower tier companies and their markets in the industrial base, changes in how we work with them, and methods and strategies to achieve our long range objectives wherein we are dependent upon suppliers.

In essence, resource market planning is a process of linking the organization's business objectives with its dependency on supplier organizations and markets in a systematic, long-range and strategic fashion.

Procedures and Steps in Resource Market Planning

Although the next two chapters will provide in-depth materials on the process of performing strategic planning and management of resource market relationships and interfaces, this chapter begins an introduction.

Much of the strategic planning for procurement is derived from situational analysis. A situation emerges wherein there is a perceived threat or an opportunity which must be studied for actions to be taken. Situation analysis as a basis for planning is usually reactionary planning. It includes recording of supply histories for industries as a basis for projecting expected actions and trends. Proactive effort is rare, when situational analysis is the basis to plan actions.

However, the proactive minded procurement manager can utilize situation analysis for his benefit. It is highly diagnostic in nature and involves a fairly sophisticated planning ability. It includes technological forecasting, as well as manufacturing and product line forecasting for supplier organizations. Such an approach provides the important time perspective for planning responses. However, this still may not include entrepreneurial efforts.

The crux of situation analysis for procurement lies in finding problems and opportunities before they arise and in articulating the salient issues for management decisions. This might include perceived emerging trouble spots in supply, hindrances to competition, cost reduction opportunities, or new technologies or products under development which might be utilized by the buying organization.

Broadly speaking a strategic resource market plan is a document that sets forth, from environmental or situational analyses, (a) business goals with respect to the operations and requirements needed from the resource markets, and (b) actions--hopefully proactive--needed to be taken to assure these requirements are met in the future. It is an organized, documented, written communication which does the following:

- (1) Defines the resource acquisition situation, past, present and future.
- (2) Defines opportunities and problems facing customer organizations of specific resource markets and vendors.
- (3) Analyzes these opportunities and problems for decisions.
- (4) Defines specific acquisition strategies and programs required to deal with the problems and to capitalize on the identified and selected opportunities.
- (5) Pinpoints responsibilities for execution of programs--including organizations not formally housed in the procurement function.
- (6) Establishes timetables, resource commitments, and controls for program execution.
- (7) Translates objectives and programs into resource forecasts and budgets--material and technological--as a basis for further coordination of internal decisions.

In achieving these factors, strategic resource market plans are not unlike operational strategic plans--except they focus on resource markets and internal needs, as opposed to forward sales markets. Regarding the perceived role of procurement in doing such planning, one materials manager made the following comments:

We should do a business and technical strategy plan for materials over the next five years, including areas like international offsets, coproduction, codevelopment, and critical materials. Our strategic planning does not do this. We in procurement are a doing organization--we get out and do things, and are not, by nature, a thinking and planning organization. So this is difficult for us to perform. We should do it, but don't.

In the early part of each year, however, we put together a business and technical strategy about which we we plan to go with suppliers, with numbers on it. However, it is short term oriented. In 1979 we had an objective to strengthen our source selection process. This was merely a procedural change, and not a strategic approach. It is still a program that if we recognize that a major vendor is in trouble, we are in trouble. We don't try to determine or predict if he will be in trouble. We need a better plan to reflect and analyze our strategic dependence on vendors.

Another materials manager noted the following:

Last year we had a new planning procedure which included vendor capacity planning. Adequacy of this is no longer an "assumption." We are in the first iteration of a procedure involving a whole section in the strategic plan that covers a ten year period that will include vendor capacities. So far that is the only resource market-related area in the strategic plan for this organization (division).

What other actions should and are done by aerospace companies? This question will be answered in detail in the next two chapters, including examples of procedures which were found by the researchers in the cross section of companies that was studied.

Summary

This chapter has introduced the concepts of resource markets and source/vendor base planning within those markets, the dynamics of those markets with respect to vertical tiers and horizontal, interindustry competition. It has also provided an introduction to the process and content of strategic planning concerning resource markets. Finally, it has provided some of the comments received from materials managers who have recognized the need for and importance of strategic planning concerning resource markets, and some of the initial efforts which have been done in this regard.

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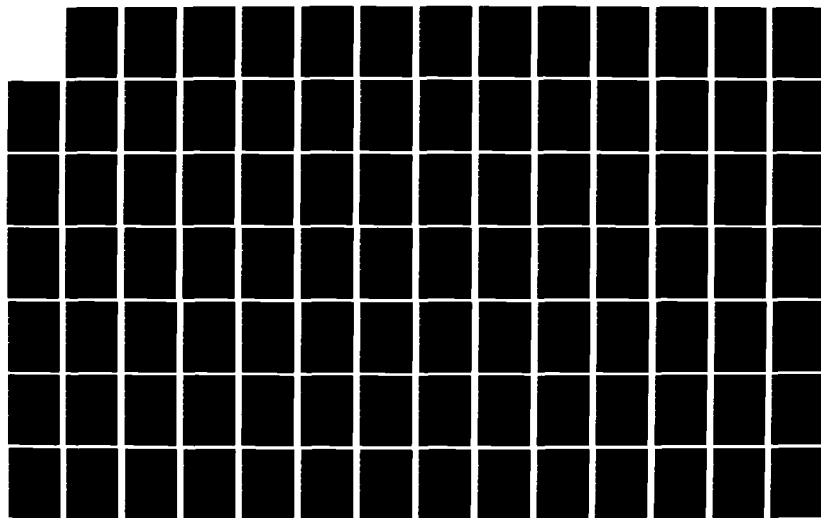
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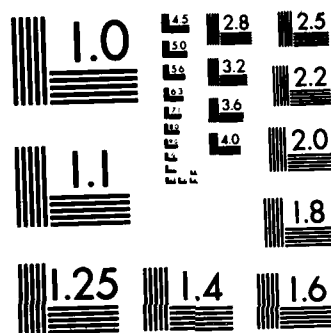
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Chapter X

INTRODUCTION TO ORGANIZATION AND PLANS CONTENT

This chapter discusses the following areas: (1) Four categories of ways in which materials managers can perform strategic functions, (2) resource market dependencies and the need to manage the distribution of risk with supplier organizations, (3) the concept of a system of plans in resource market management, and (4) a discussion of important areas of strategic management emerging within the procurement organizations of DOD contractors.

Categories of Strategic Functions

Strategic functions that can be performed by materials managers are of four basic types:

- (1) Relationships with the strategic management and planning function in the organization.
- (2) Internal operations of the materials function in a strategic manner.
- (3) Strategic resource market research and information
- (4) External strategic initiatives.

The most common strategic function being done within materials organizations was providing coordination and interface with the strategic planning process in companies and divisions from a materials perspective. In many cases this involves reviewing strategic plans at the appropriate organizational level for materials issues. At the SBU level, a divisional or plant materials manager reviews the strategic plan for long-term materials requirements and supplier capabilities. This can result in highlighting potential problems or indicating to SBU managers where resource constraints may be occurring.

A second areas of strategic management is in managing the materials organization in a strategic manner. This could include training personnel in the techniques of strategic planning, providing incentives for strategic

and long range thinking and problem solving, as well as developing strategic documents (systems of plans) for management of resource market relationships and activities.

A third function involves the acquisition of information upon which strategic decisions can be made concerning resource markets and acquisition programs. A specific information gathering and organization task can provide important information and projections about resource market trends and expectations which can become the basis for identifying strategic issues and needed actions.

Finally, external, proactive, entrepreneurial initiatives by the materials function seeks to develop resource capabilities which would not, in and of themselves, be forthcoming if left unattended by a passive materials manager. This might include developing new suppliers, interesting suppliers in putting efforts into new technologies or products, or increasing the competitiveness of a supply situation. Each of these four strategic functional areas will be developed within this and the remaining chapters in this report.

Functional Subsystems in Planning

An effective strategic management system for resource markets necessitates the implementation of three important subsystems within the materials function: an organizational subsystem, an information subsystem, and a decision subsystem. The organizational subsystem, centered in the procurement function, involves various organizational changes and categories of tasks to perform strategic management. Typically, organizational changes include the establishment of materials strategy councils and commodity committees with the responsibility of overview and recommendation of strategies pertaining to specific strategic commodities. This function will be discussed in more detail later in this chapter and in a subsequent chapter.

The flow of planning and management effort must involve a coalition of effort, often among various plants and/or divisions, as well as modifications in the procurement organization itself. The end result of such an organization change can be increased use of company-wide contracts or merely the standardization of parts and components bought among divisions.

The information subsystem involves both internal flow of information about planning requirements and decisions among organizational units, but also external information flow. Information systems include both continual information gathering about resource markets and vendor activities, as well as ad hoc studies of specific resource problems. Information flow must also occur to vendors from the buying organization, particularly long-range and strategic plans wherein the support of vendors is important.

The decision subsystem is the formal committed plan which identifies the strategic alternatives and documents decisions and courses of action which will be taken to assure a strategic position of the buyer relative to resource needs. This document, the strategic resource market plan, portrays the decisions regarding resource market efforts over a time horizon of several years. Various sections of this plan will be discussed later in this chapter and in subsequent chapters.

Systems of Plans

Strategic planning for the procurement function is not merely one plan, but a system of plans. This system of plans is a composite of integrated efforts in subplans which address specific aspects of the resource market planning effort. For example, the contractor may generate make or buy decisions for materials and technologies through a "make or buy subplan." Such a subplan would address both a specific program make or buy plan as well as long-range critical and strategic issues, such as security of technological information. It would include decisions and requests for budgets to support planned long range in-house manufacture efforts.

Two important subplans are the critical materials subplan and the critical technologies subplan. Critical materials planning, as will be discussed in the next chapter, involves identification and analysis of critical materials usage requirements together with a strategic assessment of the availability and pricing of those materials over an extended time horizon. The technological subplan does the same function but relates to technologies and capabilities of technologies, rather than physical materials per se.

Figure 46 lists several specific subplans which can be developed within the overall resource market strategic plan. Several of these subplans will be developed in greater detail in the following chapters.

<u>Subplan</u>	<u>Content</u>
Resource market relationships plan	Identifies the intercompany relationships sought over the planning horizon concerning the resource market and specific suppliers in the market. Style of relationship may run from "hand to mouth buying" to contractual long term relationships or even acquisition and merger.
Product/services definition plan	Identifies, from marketing plans, the specific products and services to be sought from the resource market.
Technology definition plan	Identifies, from the marketing plan, the performance and production technologies which will be sought among suppliers over the planning horizon.
Resource-Base development plan	Identifies specific instances of current and emerging inadequacies in the resource market, objectives and programs to remedy these inadequacies among supplier institutions.
Logistical development plan	Examines the logistics of supply relationships with resource market organizations and areas for needed development of logistical facilities.
Financial management plan	Focuses on major capital and financial needs and the management of contingencies and financial risks between the buyer and supplier organizations.
Manufacturing analysis plan	Focuses on manufacturing systems and technologies of supplier organizations, and specific needs to be remedied in manufacturing capacities and capabilities.

Figure 46 : Subplans of the resource market strategic plan.

Distribution of Risks

Resource market planning is a relationships process and involves planned and, hopefully, agreed upon relationships between various buyer and marketer organizations. These relationships are fraught with risks of various kinds, and the plan seeks to identify and provide an equitable distribution of these risks. The more custom and high technology the development under question, the more the risks than may be perceived. Strategic planning and management efforts should serve to convince potentially active and responsive sources that these risks should be acceptable. In the long-run, acceptable risks are only possible where down-stream sales are highly probable. In this role, the credibility of strategic planning of the buyer organization serves as a major risk reducer for lower tier suppliers.

A first tier contractor can play a key linkage role for DOD in technological planning and reduction of perceived risk within lower tier organizations. In many cases, where the contractor is able to leverage risks with commercial applications this has proven important. Other important risk reducing efforts of prime contractors include:

- (1) Ability to identify and market systems to potential foreign customers.
- (2) Subcontract offsets for the buying country.
- (3) Ability to accurately predict which programs will survive government agencies' scrutinization and budgeting tasks.
- (5) Having minority equity investment in suppliers to share financial risks.
- (6) Providing loans or loan guarantees.
- (7) Cooperation and teaming on R&D budgets and efforts.

Incidence of Strategic Planning

What factors determine the incidence of strategic planning by materials managers and the nature of that planning? Studies have shown that in general European firms do more strategic planning for materials and technologies than do American firms. Perhaps this is because many

European countries are more resource dependent on the world market. Whether or not this is a major reason, American firms generally have substantial progress to make to reach the level of involvement and quality which many European firms have.

As the percentage of materials, technologies, and manufacturing that is obtained from the environment increases relative to that acquired or produced internally, strategic planning will become more important to management. Many important factors such as technological risk, costs of capital, economic risks, and specialization of capabilities have caused an increase in the percent of dollars being spent outside of contractor organizations.

Respondents in one survey study indicated that in the past decade one of the major motivators for more strategic planning for resources has been the adverse cost trends for materials. Such a motivational stimulus tends to place strategic planning in a situational, reactionary mode. Perhaps if and when cost drivers are reduced, management will revert back to non-planning. In most of the companies studied by the authors of this report, there seemed to be an appreciation for and interest in strategic resource market planning founded upon resource constraints--availability or price--rather than as a process of sound management. Sincere commitment to strategic thinking in materials management is based on long-range thinking and the notion that entrepreneurial strategies are just as important on the supply side as on the marketing side.

More permanent responses include the use of broader contexts of strategic issues. Among companies that seemed to have a more long-term and permanent focus on strategic resource market planning, the following were the indicated areas of application:

- (1) A greater recognition of the importance and value of strategic planning by the procurement organization in support of new product and program development.

- (2) More use of company-wide purchasing agreements as standard practice.
- (3) Where procurement organizations are formally established at the corporate or major divisional level, they are also involved in strategic decisions which influence the company and division as a whole and are concerned about the flows of information between departments and their resource requirements.
- (4) A wider recognition of the need for permanent research for resource market information and associated forecasting as a part of the role of materials management.
- (5) A greater recognition of the need for standardization of items and the use of common components in various plants.

Of some 110 companies surveyed by a team of researchers regarding "future shock" of the procurement organization, wherein assured access to adequate supplies of high quality became more and more a strategic issue, the following strategy questions were seen as critically important:

- o Will materials be available to allow previously anticipated company growth rates over the long term?
- o Will supplies of proper quality be available to ensure continued production efficiency?
- o Can new products now under development go into production on schedule without constraints from suppliers?

Such basic questions have led managers to develop materials requirements planning as a part of operational support. However, this focus, which is often provided as strategic planning, merely looks at supply logistics and assurance in the short run. The following case of a chemical company illustrates strategic planning as it pertains to strategy development over a long-term horizon:

A manufacturer of polyethylene products was regularly receiving a priority allocation of resin from a supplier in the chemicals industry. In proposing an aggressive promotion (in a strategic plan) of existing lines, the marketing manager introduced plans for a new line of

polyethylene-based products. His reasoning was that with rising prices for materials (resin) and its raw material (ethylene), the petrochemical producers would begin to have a new round of production expansion which would be "on stream" by the time the new line was to be introduced.

However, a closer study by a planning group indicated that despite shortages and government regulated priority allocations, the producers were unwilling to expand production unless supplies of feedstocks, such as naphtha, were assured. (In this case the end producer bought controlling interests in feedstock production under a sole supply arrangement to a resin producer.) Since naphtha was produced by refineries, of which only a few had announced expansions, the possibility of expanding polyethylene resin production was not valid. However, this analysis into lower tiers of the resource market for naphtha was done before the new product planning had already gotten underway and this allowed time for strategic changes in the marketing activities to occur.

Strategic planning by the procurement organization should pinpoint key considerations upon which strategic objectives and actions are built. That is, it should be diagnostic as well as prescriptive. Diagnosis of strategic issues in a market and situational analysis requires a well-prepared base of facts and information. This is particularly important concerning the dynamics of resource markets, but it is also important that planners examine the buying needs and practices of competitive buyers, such as those also needing naphtha.

As a basis for strategic resource market planning, procurement managers can focus on such areas as:

- (1) Finding key points of leverage for increasing profitability through acquired resource acquisition strategies.
- (2) Identifying resource market growth rates and changes.
- (3) Studying the nature of the supply/demand competitive

environment, capacity utilization, price trends, number and size of competitors, and changes in vertical integration.

- (4) Examining trends in manufacturing technology, potential process breakthroughs, research and development efforts of lower tier organizations, and changes in managements.

Finally, another strategic response found among companies was the establishment of business strategy panels for procurement decisions. Such panels serve to review major procurement decisions from a multi-departmental perspective and operate as a sounding board for discussing procurement strategies. They can review, for example, the requests for proposal (RFPs) which are sent out for strategy and content, or can serve to review major proposals involving the distribution of financial, technological, and program risks involving lower tier organizational relationships.

Organization and Policies for Procurement

Typical of the organizational approaches to strategic management of resource market issues among aerospace companies is the use of a procurement council. Membership in such a council is usually based on various locations representing specific commodities based upon usage volume. Concurrent with or optional to this is to have a representative from each business sector or group on the council at the corporate or major divisional level. The council is divided into procurement or material subcouncils specializing by commodity or major subsystem/resource market segment. Another subcouncil used is manpower development, and some organizations have subcouncils for other functions, such as make or buy.

A typical subcouncil focus is shown in the following example for semiconductors which existed within a large electronics contractor company:

The procurement manager in this organization commented to the authors:

In semiconductors, this year we will use about \$190 million, and we will buy about \$145 million of that. We expect that by 1985 this will be about \$840 million. One out of every five purchase dollars goes for semiconductors, so it is a very important commodity to us. We expect to have four people manage our semiconductor resource market efforts in the U.S. alone. This will involve a new element called planning and they will develop short and long range business plans that will be approved by the procurement council.

The procurement manager also went on to describe several other strategic changes in the organization and operation of the council. One of these was in relation to vendors. The council examined specific programs to ensure long-term vendor relationships, which could take the form of licensing, dedicated lines of production, stock ownership or other type of relationship to obtain the needed vendor support for long range needs.

The procurement council was charged by top management in this organization to periodically review specific commodities to move them back and forth according to judged criticality of resource market issues. The focus of the council was to look out five years to determine not only what would be happening in the resource market with respect to suppliers, but also what the company would be and should be doing with respect to acquisition strategies. The procurement manager made the following comment:

We are planning for a world of a "smart everything," and this will put a huge drain on the industry to supply semiconductors to companies who are not now using them. There is a subcommittee of the procurement council that deals just with the military requirements and looks at a technology roadmap as to where our needs will be and how suppliers will be getting there. This roadmap

spans a five year time horizon. We talk with suppliers and also with military customers to compare needs and planned capabilities. We have the tools in place to talk with suppliers about technology changes in the future and about long term relationships over technologies and costs and investments related to them. We give the suppliers our information and tell them the trends as we see them, and a supplier can do his own long range planning based on our plans.

This company also examined each supplier and the market share that the supplier could handle over the five year horizon through analysis of capabilities and capacities. A semiannual survey of vendors was conducted and in some cases items which the company must buy from vendors which were no longer available from vendors became critical items. In such cases, the company used "life of type" procurement where it bought a long lead supply from the vendor based on projected needs, then the vendor closed down production of the item.

Finally, the company management noted to the researchers that the subcouncils were developing long range plans for developing sources in areas where key technologies were needed. This development included both technological, financial, and managerial development as needed by the vendor. The focus is to look at the vendor in the conceptual stage as to what would be needed to "bring him along" where needed. The planning establishes milestones in areas such as facilities investment, and the vendor then submits a plan to reach the milestones which is subject to review by the subcouncil.

Several companies indicated that there are periodic meetings with the general management in the companies involved as high technology supply houses for the purpose of exchanging information about future directions and trends. As one materials manager put it, "We let them know what we will need through 1982 (two years ahead) and they are to do something about it." In a computer/information processing company, the following situation existed:

We have a close working relationship between our procurement council and our computer requirements council. This includes

a detailed technology roadmap. It includes an analysis of our expected operating environment and products that we plan. There is a plan out through 1985 discussing where we are going both internally and externally in supply requirements. We have developed this roadmap of where we expect suppliers to be going and what our relationship must be with them to get them where we want them to go, such as teaming agreements. We have a corporate policy for each decentralized program unit to develop a detailed roadmap of technology and material plans including internal and external sourcing.

Our procurement council is also looking for ways to implement standardization to reduce costs. We have an ongoing program in this area as well as one for the availability of components. Our component engineers council meets at least once per year to decide, based on program reviews, what items should be put on a preferred parts list. They establish criteria and a lot of it involves functional reliability and availability of components, or what qualified sources are available, or how stable or improving the technology is becoming. Since it is a forward looking review, a key thing is a roadmap of the resource industries matched with our internal roadmap.

As far as source development programs are concerned, we have a number of programs within our organization where we are helping small vendors grow to meet a larger amount of our needs. These are not corporate programs, but they provide everything from pseudo-consulting to capital to assistance in learning assembly operations.

The next section of this chapter discusses examples of the organization of the procurement function, with emphasis on strategic management, planning and entrepreneurial activities. Organizational highlights include:

- (1) Long range planning manager
- (2) Advanced development procurement specialist
- (3) Specialists by commodity lines
- (4) Specialist in financial planning and analysis
- (5) Acquisition cycle specialists in development, production and contract administration.

Figure 47 illustrates one organizational response to strategic issues.

The materials function at the group level had the major subdivisions as shown in this figure. Each function, such as materials support or materials forgings and mill products, had the functions within that specialty as shown. Of particular importance in this organization are the following responses to strategic issues:

- (1) Long range planning specialist in the materials support function.
- (2) Specialist in materials growth product programs.
- (3) Specialist in advanced development procurement, where advanced technologies among vendors are involved.
- (4) Manager over strategic issues such as offsets.
- (5) Specialists in specific technologies by component type, such as over powder metallurgy procurement for forgings and mill products.
- (6) Separation of specialists in development procurement, production procurement, and contract administration.
- (7) Specialists by component types, such as airfoil, controls, fabricated and machined parts, specialty parts.

Functions shown at the bottom of this figure, such as program management, expense and satellite, reported through a separate organization structure for plant locations. With such an organizational structure, this company is in an important position to develop strategic plans by these specialty areas and address strategic issues in an entrepreneurial, planning manner.

Another important subplan area or subcommittee is that involving organizational development planning. Personnel and manpower development in procurement is becoming a challenging issue, and this is increasing as the strategic requirements become more complex. The procurement structure, usually at the corporate level, is enhanced to include a manpower development specialist. Although this normally includes training of buyers and training in operational matters, this is a key setting for development of strategic thinking and planning skills. As a corollary to this, procurement also should have controls and evaluation procedures which encourage and reward strategic thinking and actions as part of the manpower review process.

A typical example of organization of the corporate procurement function among aerospace companies is shown below. If foreign purchasing and corporate agreements have become a significant part of operations,

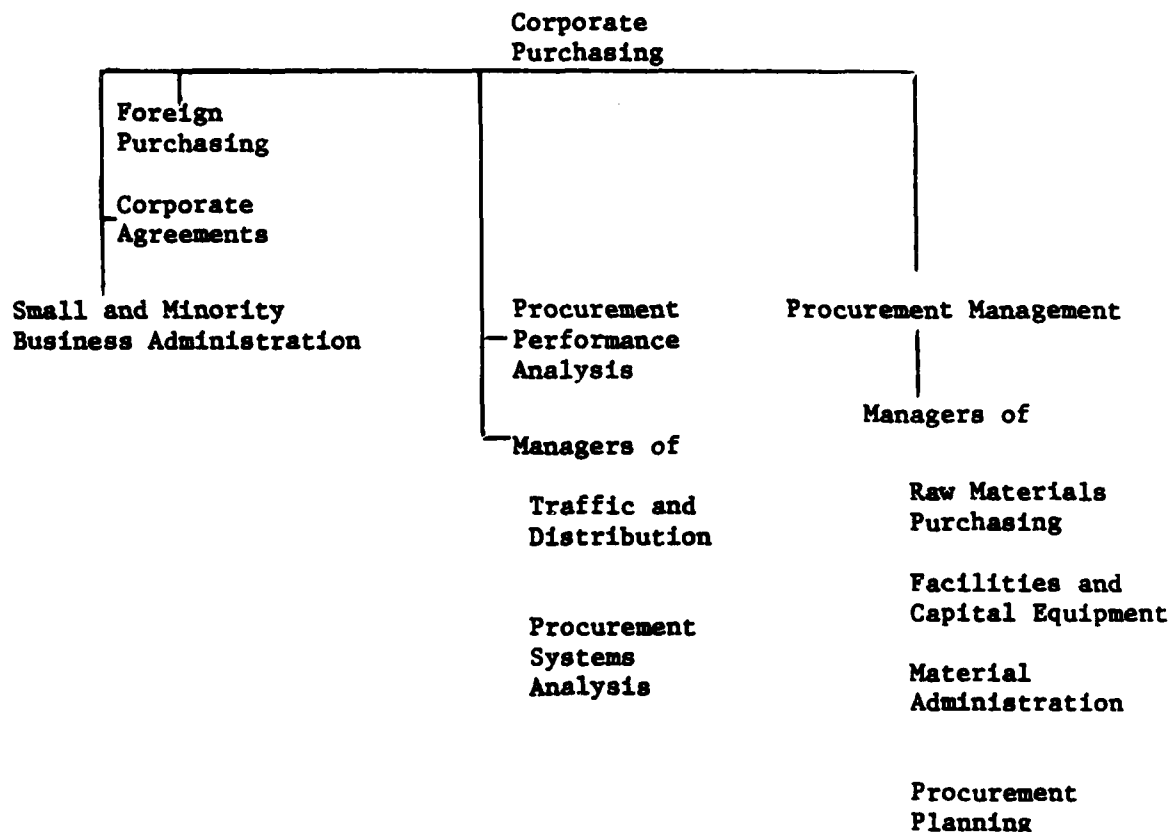


Figure 48: Procurement organization

then these two functions report to the procurement director. Typically, since the aerospace organizations are heavily involved in government contracts, they have specialists in social programs, such as small and minority business. Performance analysis is another staff function typical in procurement organizations, and many companies had traffic reporting to this function as well as computerized systems. Procurement management includes specialists in specific commodities, such as a raw material, and in major capital procurements. Procurement planning typically consists of requirements forecasting.

The authors obtained several corporate and divisional procurement policy documents and examined them for major areas of policy, with specific interest in policies pertaining to strategic resource market planning and management functions. The following listing of functions and brief listings of content came from a policies and procedures manual of one DOD contractor and represents an outline of the manual:

Material Policy

General Material Practice

Mission of the materials organization

Organization of the materials function

Concept of operation of the function

Resources required from supply markets

Surveillance practices and requirements

Operating policies for materials management

This general introduction section of the materials policy and procedures manual provided for a mission orientation, a key part of developing the operation toward a strategic, long-range and entrepreneurial perspective and approach to management. Resources are defined to include both materials and components as well as the manufacturing and technological capabilities of suppliers. Finally, the requirement for surveillance provides the opportunity to formally recognize the need to provide strategic information to and from resource markets and suppliers as a basis for strategic planning.*

Material Organization

Organization structure

Corporate material committee

Procurement review committee

Corporate Procurement Agreements Committees

Corporate Traffic and Transportation Committee

Procurement Field Offices and Quality Assurance

*This paragraph represents the authors' discussion and interpretation of this section of the manual, and was not found in the manual.

These committees were tasked with responsibilities including strategic tasks, although formal strategic materials and resource market plans were not written. Make or buy boards also occurred in the organization of the materials function, and they included long-term issues in make or buy assessment criteria.

Material Resources

Supplier base--domestic and foreign

Purchased materials inventories

Support transactions with divisions, affiliates, and subsidiaries

Manpower management

Transportation base

The orientation toward the supply market in this company was that of a supplier base--a makeup of supplier organizations--rather than a dynamic, competitive resource market. The areas pertaining to manpower development, however, contained some long range planning for manpower needs in the materials area.

Concept of Operation

Mutual support

Material business systems

Procurement operations

Logistical operations

Productivity of personnel and procurement processes

Conflict of interest and standards of conduct

Reporting of political contributions, fees and commissions

This section is typically operations and tactical policy and procedural oriented, although many strategic issues could be developed out of areas such as business systems and logistics operations as well as productivity in supplier relationships.

Procurement Operations

Major item procurements

International procurements

Microelectronic purchases

Outside fabrication purchases

Commodities and services procurements

Procurement agreements

Small purchases and cash procurements

In these product categories of procurement, management felt that the issues and characteristics involved in procurement were different enough in each area to develop specific policies and procedures. This approach can also be an important starting point to develop strategic resource market plans for such categories as international procurement, industries such as microelectronics, or specific commodities. However, typically these sections of policy manuals merely discuss tactical and policy operations, not methods and procedures of strategic planning for the categories of procurement.

Advance Procurement Planning

Some of the companies studied had this section in their corporate materials manual, but it tended to be limited to planning for specific procurements and contracts and not aimed at issues in resource markets or long-range issues pertaining to requirements and resource market capabilities. Furthermore, rarely were there descriptions of policies toward entrepreneurial or proactive efforts.

Proposal support writing

Proposal planning

Proposal pricing

Procurement lead times

Proposal narratives

The procurement lead times section is typically limited to forecasting and reporting lead times, largely from published industry sources and usually only within one year.

Asset and Resource Management

Make or buy analysis and decisions

Manufacture or purchase planning

Major item procurement index

Supplier resources

Teaming agreements

This section also contains many potential strategic issues, but typically it is not applied in that manner. Make or buy analysis is usually done on economic or technological logic, not on long range dependencies and risks. Supplier resources focuses on current and short-range capabilities, not long range needs and seldom on proactive efforts to develop these

resources. Teaming agreements policies apply to the process of making and committing to such agreements and not to their strategic role in technology and/or materials resources development.

Program Support

Material program planning

Material contract briefs and summary listings

Procurement preaward plan

Defense material system and priority system

Again this section is highly tactical and merely descriptive of procedures for doing such planning and analysis on a contract by contract, program by program basis. This section is often the most tactical and operational of the manual and is quite similar to a Defense Department operating procedure and regulation document.

Requirements Generation

Purchase requisitions formulation and processing

Technical descriptions

Statements of work

Quality assurance review

Data requirements

Requisition approvals

Sales and use taxes

Options

This entire section of the manual is often oriented toward only tactical and "how to" operation procedures, rather than such areas as long range requirements generation for availability analysis.

Competition

- Establishing competition
- Bidders listings
- Market and catalog items
- Alternate source development
- Single source, sole source and directed procurements
- Debarred, ineligible and suspended suppliers

Although potentially a very strategic section in the procurement manual, this section often deals nearly 100 percent with procedures, policies and steps in developing and managing competition. Particularly in DOD contractor companies, this section merely describes ways to comply with DOD requirements on obtaining and managing competition, and not with strategic issues influencing the nature and process of competition within an industry and competitive strategies of supplier and buyer industries and organizations.

Supplier Performance

- Government source quality assurance
- Company source quality assurance
- Other items not listed herein

This section relates merely to a contract by contract performance assessment of suppliers, and not to long-range capability and performance decisions and strategies.

Terms and Conditions

- Terms and conditions
- Procurement contract types
- Procurement document attachments
- Overriding agreements
- Royalties
- Progress payments or advance payments
- Value engineering

Here the approach is entirely technical and oriented toward a description of "how to" procedures not strategic issues.

Requests for Quotations

An entirely procedural section on the process of soliciting requests for quotations.

Supplier Quotations and Evaluations

Entirely procedural except for occasional sections in some procurement manuals involving Supplier Capability Surveys, but such surveys are typically conducted to assess fitness and capability to perform on a specific contract.

Negotiations

Discussions of company policies and procedures on negotiations

Award

Entirely procedural, except for occasional sections describing processes of advance authorization, usually for one-two years, with little strategic planning for such authorizations.

Procurement of Specialized Commodities

Precious metals, jewel bearings, ball bearings, explosives, hazardous materials, ionization radiation, domestic licensing among the topics covered in a procedural, "how to" format. Nothing was found in such sections dealing with strategic planning for such commodities or their supply markets.

Procurement of Services

Procedural discussions

Terminations and Closures

Procedural discussions

Special Actions

Procedural actions in such areas as vendor specification concurrence, security, and communications policies with suppliers.

Material Control, Receiving and Shipping

Procedural section entirely

Storing and Warehousing

Procedural and policy oriented entirely

Traffic, Controls, Administration

Procedural only

Operations Analysis

Procedural only

As can be seen from a review of this composite outline of typical procurement policy manuals, strategic resource market planning is not very well recognized nor practiced. Under materials resources sections, one company had functional assignments responsible for the supplier base and specific supplier categories. Under the section on "Alternative Source Development" one company had a brief section on strategic development of sources and long-range plans to bring sources up to capabilities needed.

One company manual had a section which pointed toward entrepreneurial actions of procurement and its role in making major influences toward material requirements planning. This section was called "Interaction of Functions," and the description of procurement's role was as follows:

Purchasing's role is not simply to administer the decisions of others and police the system, but to be a key resource by virtue of its knowledge and access to the capabilities of the vendor community. Optimum utilization of purchasing resources should be promoted. Purchasing should project itself aggressively and should become involved early in design, requirements, QRA and other decision areas. Other functions should encourage and use earliest practicable inputs from purchasing.

This company manual also had the following policy toward vendors:

... to work with the vendor community to maximize the longterm venefits divisible between the company and the vendor community and to obtain, by objective and ethical means, a fair share of the total benefit. The company recognizes the continuing business relationship ... that... must be of mutual benefit, but does not consider itself the guardian of the vendors' operating statements.

Although a rather trite and vague statement of policy, this section could be interpreted toward the need for buyers to become interested in actions which can influence the long range viability and interests of vendors and, by so doing, strategic perspectives in decision-making. Further, the manual stated the following concerning Forward Buying and Speculation:

The company is not in business to speculate on materials. However, forward buying or hedging with commodity futures contracts sometimes may be practicable as a way to assure continuity of supply and protect the planned profitability of the company in fixed price obligations. Under those circumstances forward buying or hedging are not considered as speculation, but are considered normal responsibilities of the purchasing manager.

It appears that the objective is to preserve contract profitability, and, consequently, such forward planning and buying is seen as a tactical response to a situation. Forward buying or advance buying for the purpose of being able to remain a long term supplier to a DOD program, in areas such as titanium sponge, would not be seen as part of such a program.

Summary

This chapter has presented various categories of strategic functions which may be performed by materials managers. It has introduced a functional subsystems approach to planning and the need for a system of plans in strategic planning, examining specific areas of resource market relationships and procurement issues. These specific subplans will be developed in more detail in the next chapters. It has discussed the planning perspective of "distribution of risks" in relationships with suppliers, and has begun a discussion of the incidence of planning among DOD contractors, examining organization and procurement policy documents.

References

References listed in previous chapters.
Most materials in this chapter were extracted from reports supplied
by contractors.

Chapter XI

ELEMENTS OF STRATEGIC RESOURCE MARKET PLANS

The purpose of this chapter is to provide a conceptual overview of the elements of strategic resource market plans and the major steps in developing such plans. Plans are based on the identification of areas of risk and uncertainty about the future and involve the development of actions based on these areas of risk and uncertainty. The role of strategic planning in the materials management function, consequently, must be founded on the philosophy that materials managers desire to take effective steps in managing risk and uncertainty concerning their actions and relationships with resource markets and suppliers. Plans provide maps of entrepreneurial activities to obtain a desired position in relationship to the resource environment.

Elements of Plans Versus Functional Categories in Plans

Functional plans involve the same important elements as to operational plans, namely: scope, complexity and depth; forward time projection; resource needs; decisions and decision points in time; identification and evaluation of risks and uncertainties; authority and implementation programs; integration and linkage; cost effectiveness and measurement features, and practicality. Each of these elements will be discussed and developed in this next section.

To be useful, strategic plans require an upward flow and screening of strategic issues as well as mutual agreement on key issues. These issues must have action programs assigned to them to accomplish strategic objectives and develop functional strategies. Often these requirements are difficult to establish and manage in the procurement function. One planning manager commented as follows to the researchers:

A problem we have is how to get each function, such as procurement, to support planning and take it seriously. Often they merely do it in their heads without applying the elements of planning which are done by the operating managers. We are now going through some training exercises to improve planning capability and teach functional managers about the elements of planning. Supply/materials management is very important to us in the marketplace, and more and more materials managers are attending these training workshops. We started with technology and had our technical people learn more about strategic planning. We are now taking on other

functions and materials management has become involved on a regular basis. However, all we can do is teach planning elements and procedures, and managers must learn to adapt it to their functions and to the peculiarities of their divisions.

For example, in our commercial operations the technical driver in planning is not as strong as the market driver. In aerospace operations it is the reverse.

Procurement also has different planning issues between commercial and aerospace. In the military side we try to have a strategic posture so as not to get "locked into" a supplier's equipment. We see as a strategic issue suppliers that are losing interest in production for high reliability military equipment. The driving requirement of performance and reliability is too costly and not profitable enough for them, so materials managers must plan around this issue in the aerospace and military side of the house.

Functional categories within plans, as opposed to elements or characteristics, were introduced in the last two chapters. Categories such as critical materials availability, manufacturing resources, technological dependency, and others will be discussed in detail in the concluding chapters in this report.

Several managers stated that one of the most difficult elements of strategic planning, particularly in functional plans, is to get rigor in scope, complexity and depth. Superficiality in materials planning focuses on requirements forecasting and ad hoc responsive actions to forecasted constraints. Furthermore, a major training requirement voiced by planning managers to the authors was that of providing materials managers with the necessary vision for scope and depth to do a thorough resource market analysis.

The scope of a plan is the broad, horizontal issues and breadth of the environment addressed in the plan. For example, the concept of resource markets versus industries and individual suppliers is a construct to develop a rigorous competitive scope to planning. Another dimension of scope in

strategic resource market planning pertains to the organizational levels in planning. As do operational plans, functional materials management and resource market plans transcend organizational tiers, going from individual program and plant-oriented strategic plans to divisional and even corporate strategic resource market plans. A broadening of scope of strategic resource market issues and integration of such issues occurs as plans are consolidated upward in the organizational hierarchy.

Complexity refers to the number of interacting issues and factors in a plan. Scope influences complexity, but is not a sole determinant. The complexity of a plan is also a function of the technologies involved in an organization and between the organization and its resource environment, the complexity of organization structure, the diversity of operations, and the degree of depth addressed in the plan.

Depth of planning refers to the degree of detail and specificity in the plan. For example, the environmental analysis section can merely make note that certain factors, such as inflation rates or political unrest, are issues to address in planning, or it may attempt to build forecasts and projections of such activity. Depth and rigor in financial aspects of plans can include specific financial analysis of, say, make or buy decisions, over an extended time horizon. Scope and depth are two opposite dimensions--scope has the parameters of broad and narrow, whereas depth has the dimensions of wide and shallow. A strategic resource market plan with few different issues would be narrow, and one with superficial analysis or merely mentioning of issues would be shallow.

Another important aspect of strategic resource market plans is their forward time horizon. As they look into the future for several years, the depth may become shallow, but the scope may become more broad. To be effective, however, strategic resource market plans must provide scope and depth sufficiently far into the future to allow for adequate discretionary contingency actions to deal with problems, opportunities, and threats.

Another element in plans is the need for commitment of resources or budgeting. Strategic resource market plans must involve actions toward finding solutions to problems and commitment of resources may be in the form of such factors as manpower (needs and assignments/organization), method of contracting, length of contracts, and other discretionary resource commitments that may be employed to achieve objectives with regard to resource market requirements.

Decisions and decision points are also important elements in plans. Issues must be prioritized and developed so that decisions can be made. Decisions pertain to mission and objectives, strategies to achieve the objectives, and which programs and projects to undertake. Where contingencies arise, decision points must be identified to trigger alternative actions. Without decisions, strategic resource market plans are merely studies of issues and background documents which do not commit managers to taking proactive efforts. Studies and reports about resource markets were often presented to the authors as examples of resource market plans, but since they contained no decisions and commitments of action, they were not plans but merely guideline documents and information bases. This type of planning leads to reactive, ad hoc actions and most of the benefit of planning can be lost.

A key purpose of planning is the identification of risks and uncertainties. Such identification requires analysis of facts and trends, projections of information, rigorous thinking through of competitive actions and strategies of suppliers and competitive buyers, and the use of "what if" statements. Such identification provides a basis for formal identification of strategic issues and problems which require decisions and action programs toward resource markets and suppliers.

Authority and action programs, which have been developed earlier under discussions on organization, are also important in planning. The establishment of committees and subcouncils is one example of such planning effort. These organizational changes both come about from and are responsible for information, decisions, and action programs. Specific action programs--many of which will be discussed in the next chapters--pertain to such areas as vendor base development, capacity development, or technological exchanges.

Without linkage and integration, strategic resource market plans would not be able to cope effectively with the requirements of the organization. Functional plans must have linkage and integration with operating plans. A strategy, including those for resources, is a connecting link between a problem or opportunity and the objectives which have been set regarding the problem or opportunity. Linkage pertains to tying together resource problems with action programs, and often this linkage may take the form of changes in operational programs. For example, a plan indicating nonavailability of a specific material may necessitate an engineering plan to "design out" this material by, say, 1985.

Linkage and integration should be manifest in the efforts to coordinate the strategic resource market planning with operating plans in business units. This involves a two way flow of information. Consequently, resource market plans cannot be designed in the materials manager's "ivory tower" but should involve frequent and effective coordination. This necessity for coordination and linkage is the main reason why this report begins with a presentation and discussion of the entire strategic planning and management process in an organization.

Figure 49 illustrates the concept of coordination and linkage/integration of plans. The overall corporate strategic plan provides guidelines for planning to divisional/SBU and functional organizations, and the content of these plans becomes consolidated into an overall corporate or divisional strategic plan. There is a downward flow of guidance, an upward flow of decisions and issues, and a lateral or horizontal flow (from functional organizations) of issues and decisions.

Figure 50 shows the internal linkage and consistency between elements of strategic resource market plans and categories or subplans. Objectives should be reflected in strategies of action; these, in turn, are reflected in budgets.

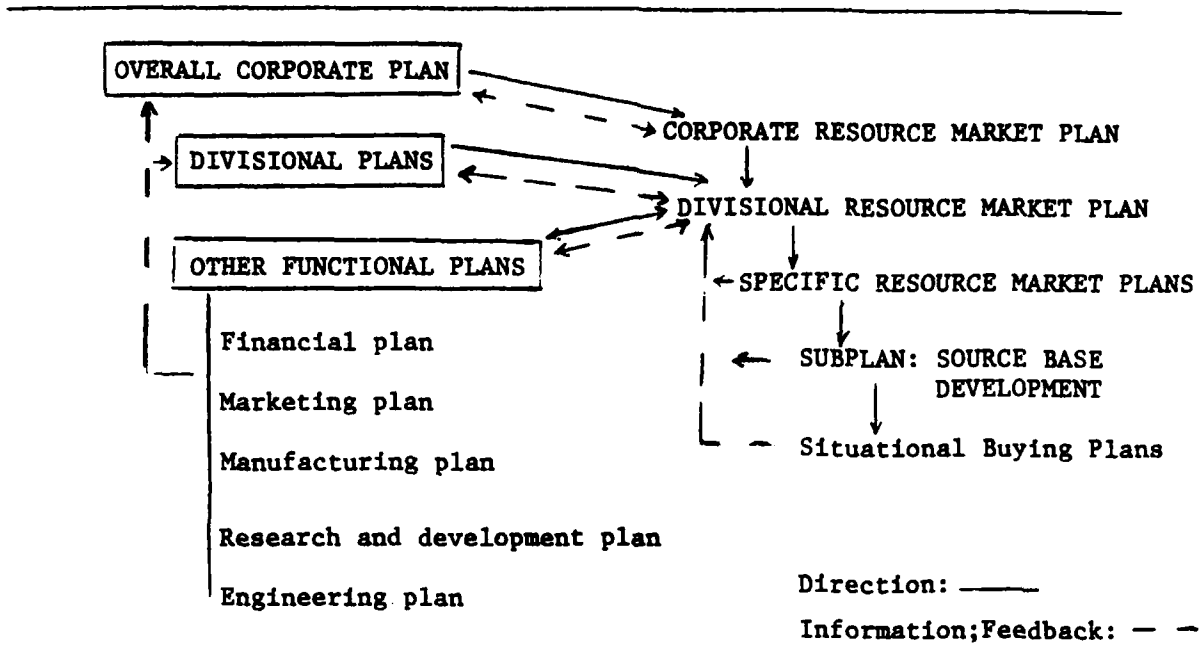


Figure 49 : Integration and coordination of the system of plans

Objectives	Strategies	Courses of Action	Proposed Expenditures	Critical Issues
Example:				
Reduce Unit Cost	Develop New Sources	Examine Source Potentials	New Facilities Invest:	Receipt of Navy IR&D Approval
		Joint Venture With Strongest Prospect	\$ X in 19XX \$ Y in 19X1	Capital Level Approved
				Cash Flow Requirements
<div style="display: flex; justify-content: space-between; align-items: center;"> ← Strategic Risks → </div>				

Figure 50 : Linking strategies with objectives, actions and budget issues in resource market planning.

Finally, strategic resource market plans should be cost effective, and the function of planning should not be merely an exercise to comply with management directions or to spend additional budget on a staff activity. Strategic planning should provide programs which are also cost effective, practical and measurable, where possible, for outcomes. Practicality facilitates effectiveness as well as cost effective budgets.

Major Steps in Developing Resource Market Plans

As noted earlier, the process of strategic resource market planning involves three subsystems in planning: information subsystem, direction/decision subsystem, and action subsystem. This section develops these three subsystems.

Information Subsystem

Resource market planning requires information concerning two perspectives: the macroenvironment perspective and situational analysis perspective. Macroenvironmental analysis examines the external environment influencing the supply situation which will be faced by the firm. It identifies facts and assumptions about resource markets from studies of geopolitical, economic, and social forces in the world which can influence the availability and pricing of materials. It studies industries supplying resources as well as those demanding or potentially demanding these resources. Macroenvironmental analysis for resource markets has the same role and perspective as environmental analysis played in the strategic planning process described earlier in this report.

Situational analysis examines more short-term problems to identify resource bottlenecks, but it also may identify issues which may have a more long-term impact. For example, a situational analysis may show that lead-times for a commodity are increasing. The issue of capacity expansion and capabilities in an industry may then trigger an ad hoc study of industry capacity over the next decade and examination of macro issues pertaining to

the demand for the industry's resources.

Macroenvironmental analysis and situation analysis provide an information base upon which a position audit can be performed. A position audit identifies and studies the buying organization's relative position and strengths and weaknesses relative to the issues and problems which emerge from studying the resource environment.

Information provided management in the environmental analysis part of strategic resource market planning should meet four important criteria. These are scope/issues, organizational responsibilities, timeliness, and accuracy. Each of these will be discussed. The scope of the environmental analysis is the breadth of perspective that is given. The extremes include merely studying specific suppliers to studying broad resource industries and potential industries. Issues pertains to the rigor and depth used in the environmental analysis to uncover emerging or latent issues, not just obvious and near-term ones.

Organizational responsibilities in environmental analysis pertains to the multi-departmental setting of procurement management. Examination of the technological environment is best done by engineering and technical personnel, not materials managers. Examination of manufacturing resources of suppliers and application of manufacturing technologies by supplier organizations is, perhaps, best done by manufacturing technology personnel in the buying organization. Examination of business strategies and plans of suppliers may require assistance from corporate planning and marketing personnel. Consequently, the environmental analysis task is a multi-disciplined, multidepartmental task and requires coordination and assignment of responsibilities to departments other than materials management to achieve the proper levels of expertise needed.

Timeliness refers to the ability of the environmental analysis to look out beyond near term horizons and predict and determine constraints and opportunities before they develop. It is important to provide adequate time to develop strategic responses and plans to emerging problems and opportunities, and not merely a reaction to them.

Finally, accuracy of information is important. Major problems in accuracy can arise from the fact that judgment and perspectives are involved, and assumptions must be developed. It is important that these areas of subjective assessment be coordinated organizationally and that an attempt is made to provide judgments from several vantage points about emerging and future resource market events and situations.

A major area of environmental assumptions involves the determination of opportunities and threats in the resource market and information about the resource market should be sufficient to identify and assess these. Political and international risks, changes in the economic and financial aspects of markets and supplier institutions, products/technological changes are all part of the opportunity/problem posture which the buying organization will face over the time horizon of its strategic plan.

Environmental analysis should culminate in resource industry profiles for each market, and such profiles provide a detailed economic and business analysis of each supplier industry, such as optics, avionics, information processing, airframes, and lower tiers such as metals and forgings/castings. Important data on resource industries include financial ratios, percent of net profit to sales, return on equity, long term debt to capital, and capital turnover.

The following quotation from one of the materials managers interviewed by the researchers adds additional perspective to this aspect of strategic resource market planning:

We put out a document called a strategic issues summary, a summary of the environmental problems to be dealt with. A world environment report accompanies this and is largely a demographic and geopolitical basis for economic forecasting for resources. It always tells about critical materials, political ramifications for supply disruption to pinpoint materials problems which may come up. It points out the materials we should concentrate on. For example our strategic plan in 1969 said that by 1980 petroleum would be up in price by twice what it was then. OPEC came in 1973, not in 1980. We saw the problem, but just missed the date for the formation of the cartel.

We generate a market research report for each resource market and it provides analysis and conclusions on such issues as the formation of cartels. We also do contingency planning for the supply market. We try to see if strikes are likely.

We have a contingency plan, say, for a six month strike at a major forgings house. We can't just stockpile six months of production. You must start a long time ago, because of the additional capacity needed at the supplier. If we see a problem like a strike, we will order extra. You can't do that if you see the strike coming in only a month. If we see a major item being dropped by a supplier or that he is phasing out of a capability in a few years, we will have a life of type buy for the item. However, you can't do this overnight either.

We have in-house experts in fuel availability and price, although they haven't been right yet. They have identified shortages ahead of time. When we get into a materials shortage, for example, since zirconium is a byproduct of nuclear production, and since that is on the decrease, we see that zirconium will be in short supply. We go to our technical people with this and they look at other industries.

Figure 51 illustrates an example of an issues breakdown for studying a profile of a supply industry. The industry can be segmented into particular groups of companies with common approaches and requirements. This might include the technology segment, or the mass production/global production segment, or some other segment. Next it is important to examine the size and growth trend of a supplier segment as well as resource market innovation trends. Further, the use of an acquisition product life cycle can pinpoint industry problems. This life cycle shows over a number of years the supply volumes which will occur and where deficiencies between this supply curve and demand will occur.

Technological trends and breakthroughs should be examined, including information about R&D expenditure levels and directions among suppliers, including a technological map. System and product integration trends within supplier industries show prospective reductions in competition and moves to consolidate with other suppliers. Alternative approaches and products that might be used should also be studied, not just the ones planned for use. Finally, analysts should examine the factors which will affect the success or failure of suppliers in the future.

Resource Market Business Strategy Issues

Resource Market Segments

The macromarket of resources, such as avionics, should be broken into segments for more detailed analysis along some important segmentation dimension.

Size and Growth Trends

A quantitative description of segments and markets should be done, including, where possible, an econometric model of the resource markets.

Resource Market Innovation Trends

Identification of major developments and innovations in products supplied by each segment or in production processes to which the acquiring organization might respond. This should be a qualitative statement of information.

Acquisition Product Cycles

Statement of the number of years and the supply volumes over those years that the product will take over time. Matched with demand profile over time.

Deficiencies/Requirements of Resource Market

An identification statement of an existing supply opportunity where a deficiency exists in current product/production approaches or where a new opportunity exists for a product not presently acquired.

Resource Market Technological Trends

An identification of technology trends in a resource market to define the timing and type of new technology that can be or will be introduced to obsolete existing products and materials.

System and Product Integration Trends

An identification of the areas in which current products and/or systems face the possibility of being integrated with other products or systems to form a new approach to the market by suppliers.

Alternative Approaches and Products

An identification of the alternative materials, technologies, or products available or potentially available as substitutes.

Major Factors Affecting Success/Failure in Industry

An identification of several critical areas that affect the success and failure in a resource industry over time together with an assessment of suppliers and potential suppliers on these criteria.

Figure 51: Some issues in resource market environmental assessment and trends.

Environmental assessment involves several assumptions. Such an assumption might be about the level of inflation in an industry or that the resource industry will face a "peacetime" level of demand for resources. A more complex, contingency-based method of analysis uses "what ifs" for these assumptions and examines the impact on the resource industry and specific suppliers. Under this type of contingency analysis, managers apply optimistic, most likely, and pessimistic examinations of criteria and assumptions. For example, a plan might address the impact of inflation on operating decisions to expand plant capacities under a rate of inflation of 8, 10, and 15 percent over five years.

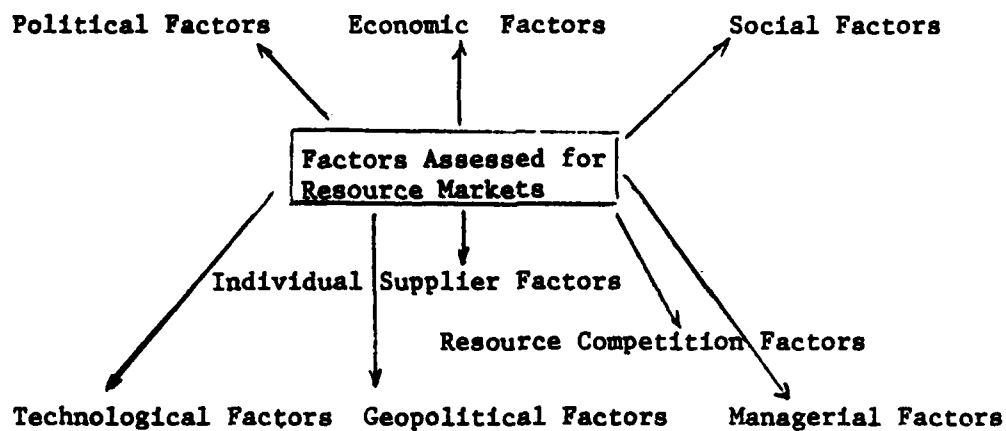
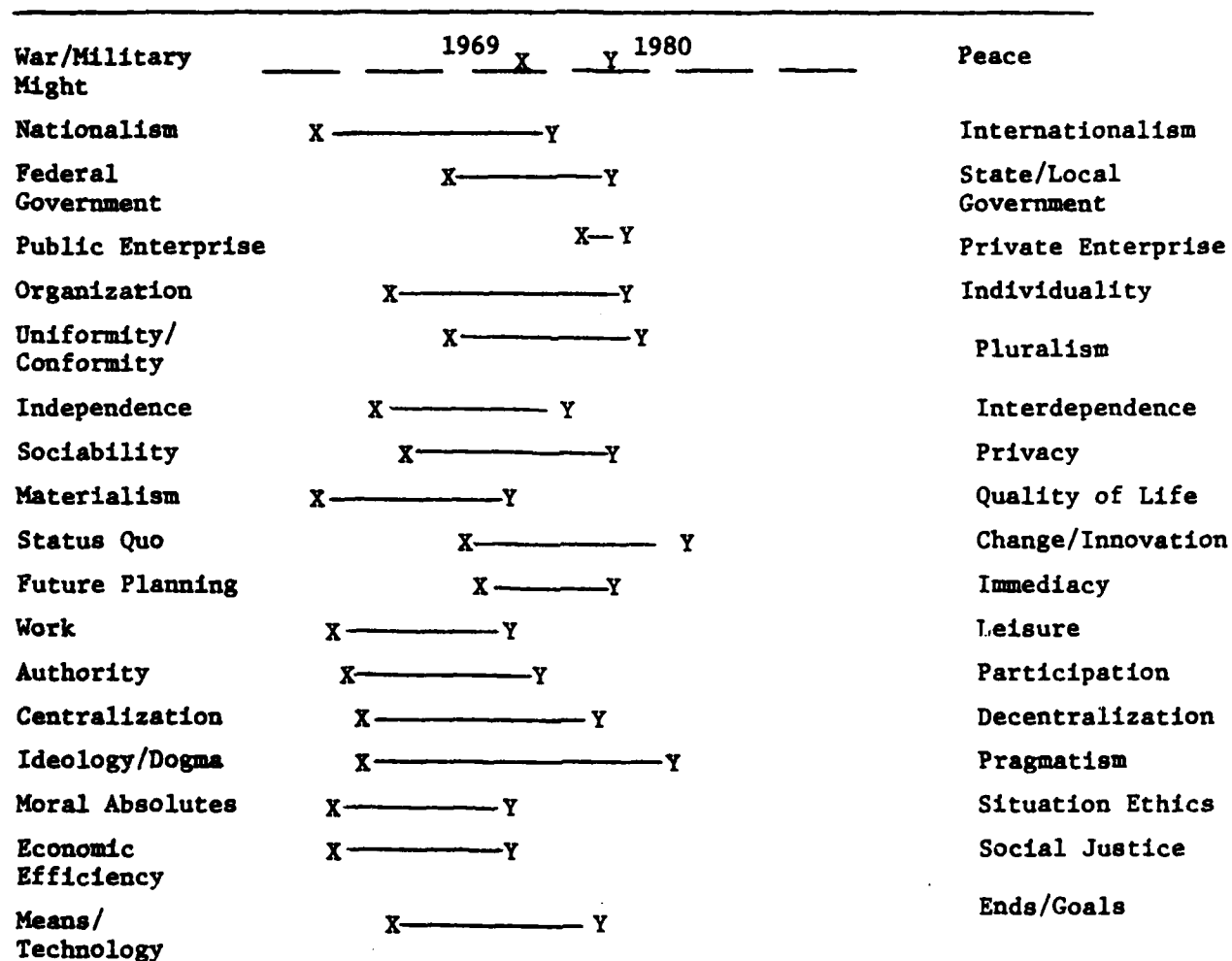


Figure 52 : Environmental factor categories for resource market assessments.

Economic changes, such as inflation rates, are derived from broad movements in various underlying factors and from macro-economic analysis of industries which are relevant to the customer. Social changes are difficult to classify and list, but among the factors here are changes in work and leisure ethics, life styles, and living standards which may influence the demand and supply of material, human, and technological resources. Figure 53 illustrates some of these changes.



X 1969 Values Profile

Y 1980 Values Profile

Figure: 53 Changing values profiles over time.

Political changes include both state and national as well as global scope and address such issues as trade between nations, foreign investment, political figure changes, defense spending, and functioning of major corporations. At the national level, changes in the regulatory environment and policies, antitrust, fiscal/monetary policies, labor practices, and environmental policies are important in examining resource markets.

Technological changes occur constantly and show little relationship to traditional boundaries which divide industries. Many important technological changes for an industry occur outside of that industry. Semiconductor technology has had an impact on a variety of industries, such as process controls and time pieces. Technology improves products, makes substitutes for materials, and meets unfilled needs. Air transportation, synthetic foods and fuels, high performance plastics, and information processing are all technological changes with enormous implications for resource availability.

The Conference Board suggested analysis of supply or resource markets to include structure of industries and future supply concentration, product differentiation, and barriers to entry and exit.

One company that was studied by the researchers provided the following perspective on the objective of environmental analysis:

The objective of environmental analysis is to develop a baseline forecast for the businesses we buy from and provide us with strategic challenges. The baseline forecast is an economic/political/business scenario which becomes available in January each year. It then interfaces with the efforts being made to develop strategic business plans. Various line and functional departments scan across these baseline forecasts looking for challenges. They look at the broad economic scan of supplier industries, technology forecasts within these industries, and the problems of integrating these technologies with what we will be doing.

The baseline forecast has also included models and matrices about supplier capabilities--current and future--and our needs. The cells of the matrix examine such areas as capacities, technologies, quality assurance, personnel and technical skills and other areas wherein we find it necessary to assess the long-range potential of vendors. In some cases we have to respond by buying dedicated resources

to us over a five year period to protect lead times, technology secrets or other problems we see.

We can't do this on a supplier by supplier basis, since we have over 75,000 suppliers, but we do it for supply industries and for the suppliers of critical and high cost items, and for important technological capabilities.

Some of the companies studied operate resource market research functions as part of their environmental information analysis. Similar to the marketing research function which examines sales market opportunities and problems, resource market research conducts studies of supply markets and gathers specific information regarding supply issues. Three companies studied by the authors in the aerospace industry had market research functions operating concerning supply markets. Among the areas of information responsibility being applied were:

- (1) Ad hoc studies and white papers addressing resource market issues
- (2) Application of the strategic procurement grid and resource dependency analysis.
- (3) Professional development of materials managers toward creating a future and strategic management style--internal studies.
- (4) Changes in the traditional mode of resource market interfaces, including increased use of engineering personnel in studies.
- (5) Program and period-oriented materials planning

One company commented that it did resource market studies across various supply industries, and the materials manager stated:

We have complete studies on our resource markets and the output of these studies is included in strategic plans. They get reflected in contingency plans. For an example,

*The procurement grid is a cross classification of specific procurement functions: market/product selection, channels of communication and communication instruments, cost/price analysis, and information systems.

the redesign to cut out cobalt in the event it is not available. Somebody looks at the contingency scenarios and comes up with needed studies. Those with the highest probability of occurring will be proposed as studies.

On the materials side, the long range planning for material tends to be oriented toward determining availability and price problems as contingencies. Our strategic plan focuses on key vendors and is also communicated to vendors occasionally.

Another company used resource market economic base studies to identify what it termed "strategic challenges" for the planning period of the strategic plan. The manager made the following observation:

The purpose is to set a baseline forecast for the operating environment in terms of materials in short supply, interest rates, price increases, productivity, impact of energy, and so forth. Our market research people examine supplier industries from this perspective and prepare an annual report in addition to ad hoc studies.

A third company had a full time market research person working to uncover issues of strategic concern with suppliers. The materials manager of this large missile producer commented:

For example, when Mt. St. Helens blew up in May 1980, we spent a lot of time with Bonneville Power Authority to find out the implications of that on the Columbia River. Since a lot of aluminum is processed in the Northwest, when the river was obstructed, it had a potentially severe impact. We worked with ALCOA, Reynolds, and BPS to generate some information and make it available to our program managers and to the Chief of Naval Materiel and to our suppliers.

We just completed a seminar last week and one of the things we told suppliers was how much we need their information. We are providing them out to eight years of planning information, every year, about our company. It tells suppliers the quantities over time and their particular requirements.

Out of our research program have come some interesting revelations. These have caused us to make some additional procurement for the life of our programs. Long leadtime procurements, such as for titanium castings and forgings, were also bought as well as high quality aluminums.

In some of our electronics, like semiconductors, we think this will be quite beneficial. Our suppliers are part of a family and we know that they know better than we what will happen. We try to get a dialogue established. As a consequence, we are exchanging more information with them.

I visited a supplier a month ago and OSHA requirements in the chemical industry was the issue. The supplier said that there were serious repercussions, but he was unaware of our market research on this issue. It had not gotten to him yet. As a consequence of the meeting, he is now sharing information with us, and is a vital part of our research network.

We found out that Japan is taking most all of the recycled aluminum out of the US and using it. It takes less energy to convert it to usable aluminum. This robs us of cheaper aluminum, but we have no U.S. policy against it.

In order to help shelter some of the risk of lower tier companies, we are providing them with planning information about both our needs and our views of supply markets. In some instances the information goes out seven years.

In other research studies done by aerospace companies, but not through formal market research organizations, the information has pinpointed strategic problems which had not been clear to management. The following example is from a materials director in a large aircraft organization:

We review resource markets looking for issues, such as in raw materials, subcontracting needs, or capacities and volumes. From this we take a long term strategic view of what we must accomplish. For instance, on two of our DOD programs, we averaged in FY 1979-80 over \$20 million in our own dollars for advance purchases of materials, and we had 100 percent termination liability. If DOD cancelled, we were out, but our research indicated that something had to be done.

In 1974 we started doing a study on principal commodities, like aluminum sheet, plate, titanium sponge, sheet steel, castings, and so forth. We also did a supply and demand study for aluminum through the past decade. It showed the two crossing at a point in time --1978--and we expect there to be excess demand through 1981. We did some joint ventures with some of our suppliers to double capacity in areas like titanium sheet.

As a result of another research study, we are working with a company in Australia for more sponge supply and are negotiating a contract for offset work in exchange for this. We are presently doing market analysis on castings and forgings and on the demand for titanium sheet. The military market is about twenty five percent of demand for large forgings, and the industry now has bookings of some \$3.5 billion through FY 1982. We are prepared to buy aluminum billet stock if there are no forgings and "hog it out" ourselves to protect leadtimes.

We have also done a demand study on surge, and we have about 2000 suppliers with a rough idea concerning their surge capabilities. Most could go up fifty percent or more and we could too. Our studies have shown that it is not so much a fact that the number of sources is down, but it is one of a willingness and interest in bidding on government work is down. We had a forty percent no bid rate in 1971, and in 1979 it was seventy percent.

Another materials director indicated that sales market research was playing more and more of a critical role in relationships with suppliers.

He stated:

It is our job to sell the suppliers on the credibility of our market forecasts so they will invest their capital to support us. We have to use their money, since it is more and more expensive for us to have a lot of risk exposure. Often when they get our forecasts, they will go out and hire a consultant and do an independent study. Often the consultants come in here for information.

A key aspect of environmental analysis is competitive position and opportunity analysis with respect to resource markets. Strategic resource market planning is based on the premise that the buying organization, the prime contractor, views its organizational competitive position vis a vis its competitors in an interorganizational setting. That is the entire technological/production planning unit is the prime contractor plus all the lower tier supporting relationships necessary for the prime contractor to meet its goals. Such an approach requires the prime contractor to perform effective competitive position analysis with respect to its resource dependencies and opportunities. The following scenario illustrates such a dependency problem:

A prime contractor was examining its competitive position with respect to a government military systems contract and knew that technologies for integrated circuits for logic devices was critical in being able to perform the capabilities desired by the customer. However, the company was not sure of the timing of acquisitions for aircraft using the systems this contractor supplied and the company was unwilling to commit its own money to lower tier IC producers for technology development.

After some four years of delays in DOD funding, the contractor found that its suppliers of ICs had decided to stop research and production on the kinds of circuits needed. After several months of efforts, the prime contractor was able to interest a supplier in making research efforts on the circuits, but funding was difficult to obtain.

When time for an award for the avionics came, the contractor did not have any technology capability in the circuitry to match another competitive contractor's capabilities nor did it have capacity in its supplier to meet the quantities that were finally funded. Since the contractor did not view its final competitive position on the DOD system from a multi-tier perspective, it did not take multi-tier risks and, consequently, had a major competitive weakness of reduced lower tier capabilities (technological and capacity) relative to a competitor's multi-tier capabilities.

This example was disguised and paraphrased from an explanation from an actual situation explained to the author by a manager in a company that was interviewed. The example was disguised at his request, but illustrates the example of ineffective system-wide strategic planning for the critical role which supplier relationships play.

Traditional procurement planning identifies various competitive indicators for sources and compares these sources along these indicators. However, rarely does this include the system-wide competitive capability of the prime contractor and key lower tier organizations. Only when the prime contractor managers view the entire interorganizational competitive unit in strategic planning are they likely to perform necessary actions to reduce interorganizational competitive weaknesses. Because resource market capabilities can provide significant marketing advantages to the buying institution, from delivery assurance and resource volume to cost reduction and even technological development, buyers must strategically assess the

competitive strengths and weaknesses in their resource market relationships. This requires the development of issues upon which materials managers can assess their competitive buying position relative to organizations who compete at the same level--such as other prime contractors. Such a listing is suggested in Figure 54 .

Identification of competitive buying institutions--

Companies who participate or might participate in the resource market segments to which the company is dependent.

Competitive acquisition volumes and trends--

For the companies listed above.

Competitive share of the resource market outputs--

Volume shares of various buyers to determine buying power relationships. Extent to which each competitive buyer participates in the output of supplier industries and companies.

Competitors' strengths and weaknesses in supplier relationships--

Summary of the key points for each competitor.

Competitors' current and future resource objectives.

Strategies and priorities of each competitor.

Estimates of competitors costs/prices

Supply cost of key items, including terms and conditions.

Competitors' current resources applied.

For each competitor total resources applied to resource market, including joint production, facilities funding, teaming, etc.

Competitors sales products, markets and technologies

As a basis for determining future resource market needs.

Competitors' threats to the company in the resource market

Summary evaluation of competitors' profiles

Figure 54 : Checklist of issues in competitive buying analysis.

Such a listing can allow materials managers to develop key considerations as a basis for strategy development to compete in resource markets. The need for such strategies presumes the assumption that resource markets are not freely flowing with abundant capacities, looking for customers.

Such a checklist can also be complemented with a series of strategy questions on the nature of acquisition competition in specific resource markets. Such a listing is suggested in Figure 55 .

-
1. Who are the major competitors and what are their current and emerging strengths and weaknesses?
 2. What are the probable strategies of competitors and how will they affect our competitive position in the resource market?
 3. What share of the market does the competitor hold and how significant is that share in terms of strategy? Is the share changing? Why?
 4. What distinctive competence does the competitor bring to the buying industry that will give him an advantage with suppliers? How might he use this competence in dealing with suppliers?
 5. What factors of the competitor's product provide advantages in dealing with suppliers---reliability, price, margins, technical quality and reputation, design, service needs, and other?
 6. What is the financial condition of the buying competitor and how might they be an influence in buying strategies?
 7. What is the competitor's business/marketing position relative to ours in the DOD market, and how, if at all, might this influence his buying strategies?
 8. What role does R&D play for the competitor and how might he use this in buying strategies?
-

Figure 55 : List of strategy questions in addressing the competitive buying strategies of other organizations in a seller's market.

From such questions and strategy analysis, materials managers can develop a SWOPT analysis of their competitive position in resource markets. In this analysis, strengths are the things positive of which the company

doing the analysis does well relative to suppliers. Weaknesses are the things which the buyer must correct or avoid in dealing competitively with suppliers. Opportunities are factors which could or should be worth pursuing with various advantages to the buyer, while problems are the factors which may keep the buyer from success in resource markets. Threats are problems which might happen or contingent problems.

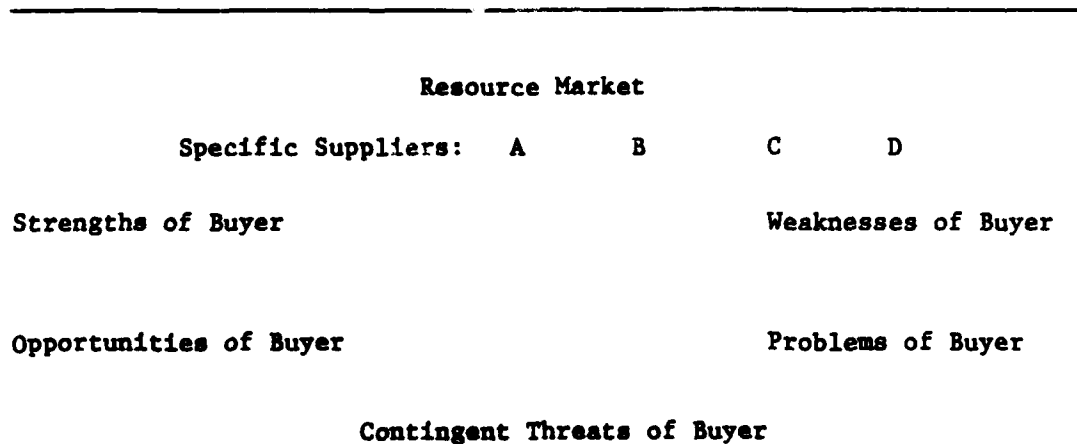


Figure 56 : SWOPT analysis in competitive buying.

The analyst develops answers to each of the SWOPT question segments shown in the above figure with respect to a resource market and to specific suppliers. Figure 56 illustrates an example of such an analysis taken from materials provided by one of the companies studied in this report. Figure 57 illustrates another example using a slightly different format. In each case these analyses were helpful to management in providing information for making decisions on competitive buying strategies. In both cases the examples have been disguised at the request of the participating companies.

SWOPT Analysis of Resource Market

Resource Market: Metals (specific kind)

Resource Market Segment: Light weight, corrosion resistant

Resource Market Strengths

Joint development of new ore
deposit discovery in conjunction
with X company (supplier)

Supplier institution Y, with whom
we have bought for 10 years, is adding
capacity.

Decision to produce product Z in house.

Resource Market Weaknesses

Political upheaval in X country, where
we buy most of our ----.

Supplier institution ABC near bankruptcy

Competitor buyer XYZ company backward
integrated.

Resource Market Opportunities

Increase in capacities and sales may
be used to induce further capacity expansion
at supplier ABC.

Long term contract offered by supplier RST

Resource Market Problems

On allocation from supplier LMN

CDE will accept no more orders this year

Imminent plant shutdown at PQR

Figure 57: SWOPT analysis of a resource market

Resource Market Threats

Supply shortage of Z metal forecast in two years.

Smaller suppliers are being bought up

Shortage of qualified manpower who knows this supply market

Figure 58: Example of SWOPT analysis in competitive resource buying.

Time-Phased Resource Market Goals

<u>Planning Unit Strategic Resource Market Goals</u>	1st Year	2nd Year	3rd Year	Priority*
Personnel					
Development of procurement planning personnel	X				1
Change in evaluation factors		X			3
New Products					
Teaming with key supplier to develop---			X		2
Source Base					
Develop two more suppliers of---	X				4
Pricing					
Reduce price of at least 10 percent on --- by ---		X			6
Quality					
Improve reliability of --	X				5
Logistics					
Improve storate facilities for--		X			8
Technology					
Get three more suppliers working on---		X			7

*Gives relative importance in commitment of time/resources

Figure: 59 Time-phased and prioritized strategic goals from SWOPT analysis.

Decision Subsystem: Strategies of Direction and Purpose

Having completed an environmental assessment and a study of the competitive resource market profile of the firm, the procurement organization is in a position to address mission and objectives. These give the organization a direction and purpose with respect to the resource market. Some of the larger contractors studied, particularly those with large commercial programs as well as military programs, define their resource market direction and purpose in an entrepreneurial manner. As one procurement manager stated it:

We say that we must have fuel controls that do these things, and we say, "You, Bendix, Ham Standard, figure out how you will do it and put your money on it." Sometimes we license technologies and materials to vendors to do this, but with no free license to sell elsewhere.

We spend alot of time and money looking for new materials to do the job and to provide new performances. I suppose that if there is anything we are driving from our shop it is materials requirements technology. Either we drive it or our competitors do.

Other examples of proactive, entrepreneurial direction and purpose are shown in the following quotes:

Our advanced programs, 5-6 years out, have involved us with a vendor and a survey of the market to pick the best vendor on the basis of technology. Then we sign a teaming agreement. Under these we have latitude to tell the vendor everything and vice versa. But we have an agreement that if we do not get the business from the government, the vendor is free to go elsewhere--it is a nonexclusive agreement if we lose. Our engineers go out and work with suppliers on technology changes. That is a must. It changes so fast that we used to buy a subcontract manufacture item, and now it is a standard component. We are buying smaller packages now.

We share data with teaming partners. Often two-three years before any DSARC decision, we are putting our money*

*Defense Systems Acquisition Review Council

behind a technology or program. But one B-1 type program in this industry really hurts a contractor in his credibility with vendors.

Another major contractor commented:

We have a program for market protection which we call "market protection investments" in materials. We give our management the option of about 18 months notice of changing the production line rates. Materials are preordered for that far in advance and we buy ahead for protection of delivery times.

Finally, a quote concerning a common feeling among contractors about perceptions of DOD programs and decisions and their interest in taking risks to support them:

The aluminum industry has all the beer can demand it can want and they have invested in it, because they are sure of it. In aerospace, once the demand peaks it is too late. The key question is "will the government proceed?" Many of the large suppliers have confidence that if they determine there is going to be a program, they will proceed with or without a contract. Our plan, as well as theirs, is to make guesses on what Congress will approve. It reads like "If we get----, as a result of ----, then we will need to buy -----." It is a contingency plan from the start!

Based on the analysis of the environment, procurement managers determine what, if any, redirections in objectives they want with respect to resource markets and suppliers. This includes the time period of the strategic planning horizon. Objectives become established in areas such as source relationships, new product or technology development, new suppliers, personnel development, manufacturing technology improvements, and critical materials availability. Explicit objectives in resource market planning can include some of the following examples:

- (1) Taking out unnecessary costs from the system through approaching component cost reduction as an element of efficiency among suppliers.
- (2) Providing for the development of new technologies
- (3) Improving the level of service provided by suppliers
- (4) Limiting inventory investments
- (5) Improving confidence and trust in forecasted business.

Objectives apply to both internal and external operations of the materials function. External objective initiatives focus on areas involving vendor relationships, living with a supplier oriented economy, instigating supplier investments, or vertical integration decisions. Internal strategy initiatives, by contrast, focus on make or buy, corporate-wide urging of materials substitutions or standardization, use of corporate-wide contracts, or organizational changes in the procurement function.

The following were comments received from a materials manager concerning formal planning efforts toward setting objectives:

We use a narrative plan that addresses areas of contingent risk in business and technologies. In the front end, we commit to delivery and to a cost. This becomes a plan of record. We start with a bill of material, lay out our yearly needs, look out seven years and plan to buy for each of these years. Buyers are measured on their target cost versus their actual cost and are tracked by program. We use environmental economic studies of the supply industries in setting these targets. We really work at tracking the IC industry. Sometimes we buy ahead of a plan due to an anticipated supply/demand imbalance at a supplier or in an industry.

However, this is really not strategic planning, it is tactical. We mostly react to pressures and problems we see coming up. Some things you can't plan for and you react when it hits you. Suppliers say, "We can't get the job to you on a six month lead time any more." Then we react.

The relationship between information analysis and objective setting is not precise. However, figure 60 illustrates the general flow from one step to another. Objectives often trigger the need for

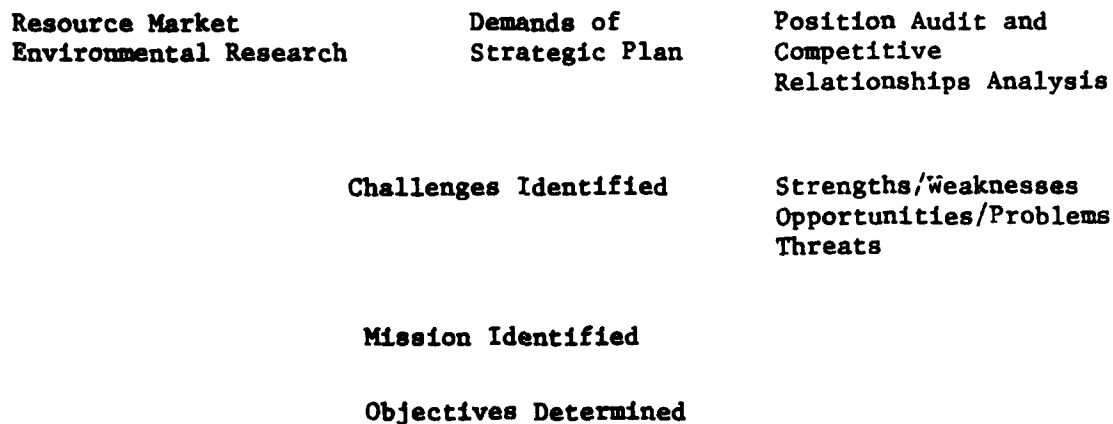


Figure 60 : Flow process from information subsystem to decision subsystem

additional information to clarify the options for objectives. Thus there is actually an iterative process of objective setting and information gathering. Figure 61 illustrates an approach taken by one DOD contractor regarding relationships analysis and areas for setting of objectives. The company divided its resource market issues into five categories: products, price/costs, channels of supply, communications, and information systems, and appraised its relationship with suppliers across an assessment line of unique to among the worst. From this step, objectives were set for upcoming years to improve resource market relationships.

Resource Market Relationship Analysis

Resource Market Issues:	Company Position and Fit		
	<u>Unique</u>	<u>Among the Best</u>	<u>Average/Below</u> <u>Among the Worst</u>
<u>Products</u>			
New technologies			
Volume provided			
Quality/reliability			
Performance standards			
Innovation			
<u>Price/Costs</u>			
Unit cost			
Landed costs			
Life cycle costs			
Contract terms/payments			
Risk distribution			
<u>Channels of Supply</u>			
Competitiveness			
Availability/assurance			
Breadth of coverage			
Delivery times/lead times			
<u>Communications</u>			
Contract forms/types			
Responses to RFPs			
Interest of suppliers			
<u>Information Systems</u>			
Resource market information			
Forecasting and trends			

Figure 61 : Analysis of comparative strengths and weaknesses in resource market relationships

The analysis shown in figure 61 is used to assess the buyer organization, in comparison with management's perceptions of its competitive buyers, relative to resource market relationships. This provides information necessary to set specific resource market objectives for improvement in relationships.

Another construct found used among companies is shown in figure 62 . For each major resource market issue, a detailed matrix analysis is developed. A resource market opportunity and capability is shown in the top half of this figure. This nine-cell matrix, patterned after the General Electric construct, identifies opportunity judgments for various resource market issues, such as technological development or manufacturing cost reduction. The issue is then rated concerning its relative importance to overall corporate/divisional strategies of the prime contractor during the time frame of the strategic plan. For the sake of the nine-cell matrix, the importance is rated high, medium or low. The other axis of the matrix has ratings of resource market relationship capabilities. This allows management to see just where the company stands with suppliers on important and unimportant resource issues.

Resource market factors which involve an evaluation in the upper left cell--high importance and strong capability--shows areas of distinct advantage and competency in resource market relationships. Issues where the evaluation shows an important opportunity, but weak capability and relationship provides issues for objective-setting. A three dimensional matrix, such as the one shown in figure 63 , includes the marketing objectives of the company and their relationships to a total competitive system, including supplier capabilities. In the example shown, marketing plans expect a strong rate of growth in sales volume, and, consequently, the resource market opportunity issue is surge capacity to meet the demand level. In this example, the ability to develop increased capacity in the resource market became an important strategic objective.

Matrix of Analysis of Resource Market Opportunities and Capabilities

Opportunity Issue: Technological Investment

		High	Moderate	Low
Resource Market Capability	Weak			
	Moderate			
	Strong	X		

Opportunity Issue: Surge Capacity

		High	Moderate	Low
Resource Market Capability	Weak	X		
	Moderate			
	Strong			

Figure 62: Matrix analysis for resource market opportunities and capabilities

Marketing Needs and Resource Market Capability Analysis

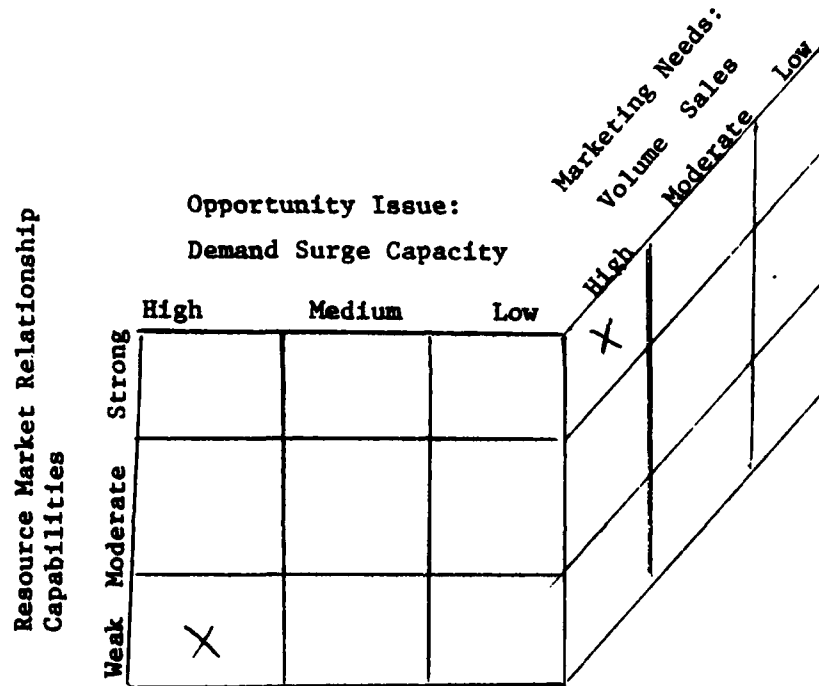


Figure 63 : Matrix for analysis of strategic resource market objectives

Suppose that the marketing objective was to gain increased volume of sales through a price reduction, application of the experience curve, and overall cost dominance. This would require a similar strategy for developing both cost reduction and volume production in the resource market relationship. This may necessitate multiple source development or development of capacity investment in a limited number of sources.

Another important aspect of resource market opportunity objectives deals with technological risk. High technology products involve such risks across resource relationships. Basically the risk involves both the technical capability and state of the art and the economic risk of recovering investments. Where a technological capability is assessed

as strategically important to the buyer organization, and the relationship assessment is weak, this can become a key resource market objective. This may mean that the company develops a teaming agreement, develops in-house capabilities, or some other response. Such an assessment is shown in the construct in figure 64 .

Technological Risk Assessment and Resource Market Capabilities

Technological Risk Assessment:

--Laser Guidance --

		High	Moderate	Low
Resource Market Capabilities	High	X		
	Moderate			
	Low			

Figure 64 : Matrix for technology risk assessment and capabilities

Here the manager assessed the risks of state of the art and economic recovery as high for laser guidance. This means that in his judgment this is a high risk area of resource development. He then assessed his resource market relationship with a high capability of meeting the areas of risk, hence there are no strategic changes necessary.

Resource Market Business Strategy Audit

Resource Market:

Date of Audit:

Major suppliers used in market: _____

Key factors influencing market supply over the planning time horizon:

Key factors influencing market demand over the planning time horizon:

Company relationships in resource market concerning these factors:

Areas of strength

Areas of weakness

Important emerging opportunities in resource market:

Important emerging problems:

Buyer's assessment of company position relative to market:

Criticality of resource market issues in buyer's resource market plan:

Figure 65 : Matrix for resource market capability assessment

Competitive Strengths and Weaknesses of Suppliers Used

Competitive Indicators:	Supplier A	Supplier B	Supplier C	Supplier D
Market position trend	Static	Growing 10%	Growing 5 %	Growing 5 %
Profitability	Below Ave.	Above Ave.	Very weak	Moderate with industry
Financial capability	Low	High	Moderate	Short on capital to grow
Product mix	Mod	High	Moderate	Innovative
Technological capabilities	Moderate	Low	Moderate	High
Cost outlook	Unfavorable	Favorable	Satisfactory	Declining
Quality	Minimum	Good	Good	Good
Product development	Minimum	Good	Satisfactory	Excellent

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Figure 66 : Matrix for assessing several competitors across strategic competitive indicators

Figures 65 and 66 illustrate other examples of constructs used in performing analysis of resource market relationships and required capabilities. Figure 65 shows a resource market business strategy audit form used in setting objectives. It is quite similar to forms presented previously in this chapter, but provides for more of a narrative analysis. Figure 66 focuses entirely on assessing the competitive strengths and weaknesses of supplier institutions as a basis for setting objectives in an entrepreneurial relationship with these suppliers.

Action Subsystem

Establishing goals alone will not improve the company's competitive position in the resource market. What is needed are action programs and strategies. Once strategic objectives are set for long and short-range time frames, strategic plans of action to achieve these are developed. These strategies are usually in specific areas of a planning document such as technology strategies, source base development strategies, critical materials strategies in the system of plans. In strategy development the procurement organization seeks to maximize its buying strengths and opportunities in the current and emerging resource markets.

Strategies are of several different types and have several different components. Strategies may apply to contingencies, and be invoked only if certain trigger points are reached. They must have timeliness and be effective within the emerging factors of the resource environment. They must be implementable. Programs and projects form the basis for most strategies and are fleshed-out approaches to achieving objectives. The following represent strategy statements taken from examples provided by contractors. Each was developed into a specific operating program:

- (1) Work closely with airframe contractors to assure coordination of long lead items in preparation for production scheduling.
- (2) Improve productivity by making investments in manufacturing technologies at selected vendors plants with risk recovery

methods negotiated into contracts

- (3) Win full-scale development contract on XX in 1981 to induce ABC company to make prototype of subsystem needed.

Specific resource market strategies are functionally dependent upon the overall, generic business strategy adopted by the buying organization's company. Three basic generic strategies are overall cost leadership, differentiation and focus. Overall cost leadership is the generic strategy of trying to dominate the cost position in an industry through high volume production, design to cost, and application of experience curves. Resource requirements necessary to support this strategy are: sustained capital investment in capacities, process engineering skills, intensive supervision of labor, low cost distribution systems, and products designed with ease in manufacture.

Differentiation applies to building a specific competence in the product or service which is stronger than that of competitors. This requires resource capabilities in creativity, product engineering, strong capability in research, corporate reputation for technological leadership and quality, and strong ability to draw together diverse business skills. Focus means concentration on a specific line or technology and it requires a combination of skills for the other strategies.

Strategies in resource markets often involve joint efforts with suppliers, and several of these types of efforts will be discussed in the next two-three chapters. Strategies of action should not only address the internal planning aspects of the prime contractor, but also the information and direction links toward lower tier suppliers. When this important fiduciary role breaks down for the prime contractor, lower tier companies are left to deal with considerable uncertainty in their markets and may reduce efforts or diversify out of these areas.

Summary

This chapter has introduced the elements of resource market plans and has developed three important subsystems in such plans: information subsystem, decision subsystem, and action subsystem. These subsystems--particularly the latter two--will be developed in detail in the subsequent chapters.

References

Materials in this chapter were developed originally by the authors in this report or were adapted from materials provided by contractors. Most concepts involve functional extensions of strategic planning materials presented in previous chapters which have been applied to the procurement function.

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Section Two
RESOURCE MARKET PLANNING

Chapter XII

RESOURCE MARKET PLANNING FOR MATERIALS

The purpose of this chapter is to present the results of a study of strategic planning efforts done among DOD contractors regarding strategic and critical materials, or the critical materials subplan of the strategic resource market plan.

Recently the group vice president of resource development for a large United States-based steel company was featured in advertising in newspapers around the country with the following issue-oriented message:

AMERICA'S INDUSTRIAL AND MILITARY STRENGTHS ARE ENDANGERED
BY A SERIOUS RESOURCE DEPENDENCY...

The strategic minerals and metals problem of the eighties takes on added significance since the experience with oil shortages in the seventies. Our nation could easily be hostage to powers and events beyond its control if the essential supply of critical materials were threatened or curtailed.

We have been slow to recognize the danger and face the unpleasant truth that America is not self-sufficient. America presently imports in excess of 75 percent of its 14 key minerals used by industry, and is totally dependent on foreign sources for five of them.

American industrial capability relies on an uninterrupted supply of critical materials. Yet the facts of life are that the major sources of most of these minerals and metals are located in either politically unstable regions, or in areas extremely vulnerable to disruption of land and sea transport.

America could not build an airplane, produce electronic equipment or manufacture weapons systems without these indispensable materials. The steel industry would be crippled by a shortage of manganese, chrome, cobalt, or columbium.

America needs a working materials strategy. And needs it now



Industry and government must unite in a commitment to finding effective solutions... like exploration for new domestic reserves... research directed toward the discovery of suitable substitutes... a realistic federal lands policy... and a contingency plan for potential cutoff. The proposed international Law of the Sea Treaty must safeguard incentives for ocean-bed mining... a promising and untapped minerals source.

While America may never achieve total self-sufficiency, it must insure its sources of vital materials and access to them. American security and industrial health hang in the balance. Can we pretend the problem isn't there? Or wish it away? We think not! What do you think?

This chapter explores the efforts and programs found among the aerospace industry toward dealing with strategic and critical materials. Included with materials are also technological resources of strategic and critical nature.

Strategic Usage Analysis

Strategic usage analysis for material and technological resources flows from the strategic directions and purposes in the overall strategic plan based on sales market and resource market environmental scanning. It is taken from the product/programs sections of the strategic plan. It is important that procurement managers determine the products and technologies that will be required over the strategic planning horizon to support their manufacturing organizations.

Resource usage analysis identifies the specific areas of resource dependency for the customer organization. It begins with an examination of the existing and future use and performance

characteristics of resources needed to meet the objectives of the future. Explicit and implicit service of supply levels from vendors are also identified and studied. Resource usage analysis must be determined from sound information concerning future products and programs, sales volumes, and performance capabilities. Where such sound information is frustrated by indecision and vascillation in customer markets--such as within Congressional and DOD acquisition processes--such analysis becomes very tenuous. The strategic planning of the prime contractor is only as good as that of the end-user customer. This interdependency of planning becomes magnified as one moves back in the tiers of supporting industry. The accelerator principle of economics causes large decreases in capabilities of lower tiers to develop as one moves backward in the channel.

With good long-range requirements coming from corporate or divisional strategic planning, the procurement manager can assess the requirements needed as a basis for looking for risks and problems in assuring supply. Criticality of materials and technologies is decided by applying various criteria selected within the organization as will be illustrated in this chapter. Critical materials, which are determined by these factors of criticality, become points of focus for resource market management strategies.

Based on a prioritization of criticality, procurement managers can make recommendations and decisions on courses of action, such as providing suppliers with financial assistance or recommending vertical integration. Often decisions are not clear and must involve the passage of time or happening of a critical, contingent event. Figure 67 illustrates one example found in industry of critical materials and technologies usage analysis.

Materials	Usage Volume and Time Horizon				Elements of Criticality
Listing of Materials	Year 1	Year 3	Year 5	Year N	Issues of criticality based on operational need and supply relationships
	Indication of years when the criticality will develop and how it will change				
Technologies	Usage Requirement and Time				Elements of Criticality
Listing of Technologies	Indication of criticality to programs and projects planned over time.				Issues of supply criticality and problems/threats.

Figure 67 : Critical materials and technological resources analysis

Since many of the factors of criticality are in a contingent setting, it is difficult for managers to select specific long-term solutions which will not require some change. Perhaps an action may be to monitor the item for a year or two, or it may require that a long-term contract be established for, say, five years. Elements of criticality in the relationship environment--such as the availability and use of alternative suppliers, possibility of substitutes, are also issues of decision. Thus, selection of action and issues contributing to criticality is often an iterative process.

Often usage analysis is delegated to one of the commodity committees of the procurement function. For example with a committee that specializes in, say, semiconductors, it is the responsibility of this committee to forecast usage analysis, determine criticality, and identify contingent issues and elements of criticality over the planning time horizon. More details on how critical materials and technologies usage analysis occurs will be presented later in this chapter.

Critical Materials/Technologies Availability

Once criticality to the organization of materials and technologies has been determined and usage analysis is forecasted, the study then shifts to assessing the supply market and the availability of the materials determined as critical. From the supply side, several important issues should be examined. One of those issues is the political aspects and world locations where supplies are produced. Commodities and raw materials are found in various places in the world and political instability can be an important factor determining availability and price. In percent of U.S. mineral imports, for example, the share of consumption in the U.S. represented by imports and the countries from which those imports come should be a part of the strategic plan.

Figure 68 illustrates four basic commodity metals important to the U.S. and the sources and prices of these as of 1976. Each metal comes largely--in two cases exclusively--from outside the U.S. and from some countries with economic/political instability or strained relations with the U.S. Furthermore, the price ratio over the six years under evaluation increased considerably. In such an analysis, strong efforts to use substitutes should be sought, and stockpiling might also be a strategy of action. Further availability analysis might include determining the economics of sources supplying the material in these countries.

Industrialized countries have tried to follow an approach of conservation and substitution as the supply of such resources has become uncertain. Currently a large number of materials in such supply weakness are critical to the U.S. and companies must plan accordingly.

Critical Commodities Import Analysis

<u>Commodity</u>	<u>1975 Percent U.S. Import Share</u>	<u>Countries of Supply</u>	<u>Price /Ton*</u>
Bauxite	88 percent	USSR, Australia,	\$8.60/\$22.50
Chromium	92 percent	Guinea, Surinam, South Africa, Turkey, Albania, USSR	\$23/\$54.94
Cobalt	100 percent	Zaire, Zambia, Canada, Morrocco, Cuba	\$2.20/\$4.67
Manganese	100 percent	Brazil, South Africa, USSR, Cuba, India	\$188/\$304

Figure 68 : Important dependence on four critical commodities.

Eleven critically important materials which influence the defense industry directly are antimony, cadmium, cobalt, copper, lead, mercury, platinum, silver, tin, titanium, tungsten, and zinc. These minerals have world-wide criticality in the manufacturing activities of several industrialized nations. This brings up an important point in determining supply strategy: the role of the country in supply strategy and the dependency of a company on its country's materials strategy. Where the U.S. policy does not address adequate solutions, companies must accept this as a problem and develop their own contingency plans.

Many projections of the availability of metals have been made, but three studies done in recent years suggest that a number of metals will become very scarce by the year 2000. The mining of metals is usually very energy intensive so constraints on capacity increases and on prices come directly into the problem. The problem of reserves, undiscovered ore bodies, and economic feasibility of extraction should also go into the supply analysis.

Critical Materials Management by Contractors

This section presents a summary of materials concerning the subject of critical materials planning provided to the researchers by various companies participating in the study. It serves to provide the reader with a "state of the art" perspective on what is happening and not happening among defense contractors concerning critical materials planning. Critical technologies planning will be presented in a later chapter.

In nearly all cases, the researchers found that whatever materials requirements analysis and strategic planning that was occurring was triggered by and in reaction to particular difficulties in gaining materials supply. Price escalations or increased delivery lead times had caused managers to do planning to try to develop better forecasts of problems and to determine which materials should be candidates for substitution or discontinuance.

Materials Planning Perspectives

To present the approaches being taken by industry, the authors decided to summarize and in several cases present direct quotations from materials managers concerning this topic. In one large company the procurement function reported to the corporate production and operating services function and was responsible for a function known as "material services." In 1973 the company experienced rapid price escalations in many materials, but forecasting and materials analysis systems did not adequately predict this to occur. The materials manager commented to the researchers concerning this:

We have much better planning since then. We have more emphasis on materials content in our programs. Seven years ago we looked at strategic plans for all SBUs and they were all sales market oriented. There was little or nothing said about materials content. Now we

have developed future cost indexes for materials and put these in the plans to identify cost projections and to show management which materials are critical from a cost perspective. We publish quarterly price and availability forecasts for key materials which have a five year time horizon to them-- that is they are updated on a rolling basis each quarter. The areas we cover are aluminum, copper, steel, paperboard, electronics and some other materials. The forecasts are made annually for five years out, and we do a quarterly update of the forecasts for two years out.

In determining which materials get on the "critical" list, management examines first the items where most dollars are spent. Typically, companies will use commodity experts on these high dollar volume materials to provide forecasts and materials resource plans. The planning examines factors which will influence both cost and availability of such materials, including such areas as political, social, and economic problems in the areas of the world where the materials are extracted. In several cases the researchers found these commodity managers developing input/output matrices on materials usage in various competitive industries.

A materials manager offered the following example of materials strategy planning:

For example, in chromium and cobalt we developed a new supplier when we saw that the one we had was going to be coming into problems with too much demand and limited supply. We anticipated the Zaire problem and said that if the source should dry up and have its supply limited because of the problems in Zaire, we would be in serious trouble. We could get cobalt from other sources, but the price would be too high. So we stockpiled cobalt for two years and also got a new source developed in Zambia and now have a man over there trying to develop a better business relationship with the source.

Several years ago we asked ourselves if Rhodesia should get its own government, what would happen? We felt this was a strong likelihood, and since much of our materials came from there, we were concerned over this politically unstable area. Embargos to cut us off would be a disaster. Therefore we made a decision to stockpile as a company the critical materials bought from Rhodesia.

The upshot of this is that we now have a corporate procedure established for identifying the national origin of all materials we use. We do an in-depth analysis of the countries of origin to determine the political factors which provide strategic criticality to us--that is the likelihood of being cut off from supply by a country.

The materials manager providing the preceding comments also developed an annual materials plan which addressed the following key questions:

- (1) What is an important commodity or resource to us from an expenditure point of view?

The company, for example, identified copper, steel, and aluminum as critical, since it spent over \$300 million per year for each of these metals.

- (2) What is unique to us where there is no readily functional substitute material without serious change in operating characteristics of the product/system?

- (3) Where do the commodity/resources come from and how unstable is the region, country, or sources that are available?

From answers to these questions the company develops a listing of the critical and strategic items that will be addressed in materials plans. Materials plans that are developed are used to highlight to the division or sector level the critical materials issues. Action plans for the materials resources are also developed and implemented as part of the materials functional strategic plan. In the action plans management tries to get an industry profile--who are the main suppliers, what is their technology, what are the government/political/social/economic issues and effects--and then determines what, if any, strategic action is necessary. The materials manager went on to comment to the researchers:

From this information we look at the opportunities and risks we face for materials. We not only look at the materials, but also at the processes involved in developing the materials. For example, castings and forgings are important. We do a worldwide analysis of the castings and forgings industries using a lot of government statistics to see where problems in capacities will occur.

This information is then provided to the divisional and corporate management and they may choose to identify the information as a corporate strategic issue. If this is done, it is then sent out to the entire company and people are told that they are to include it as a strategic issue in their planning. We merely make the information known to top management and they decide its critical issue status. The program managers then must include it as one of the contingencies in their plans and work around the constraints that are imposed by it.

As can be seen from the above statements, this company management is operating in a reactive mode toward resource constraints. As these constraints arise the company must respond in a reactive way through lengthening of the delivery cycle, increased costs or other results. These could possibly be avoided with a more proactive mode of management. However, in many cases not only are the materials managers non-entrepreneurial and reactive in their management approach, but they also tend to excuse themselves by blaming the DOD acquisition process and its inherent uncertainty of program funding as an excuse for reactive management.

Another materials manager made the following comment:

The problem we face is to look down into the lower tiers of industry and see problems before they arise. We don't buy chromium as chrome, but as stainless steel. However, we still must look at chromium as a critical material and who buys most of it in this company. Our major alloy purchases are in the form of forgings and castings, but we must look at the lower tiers materials flow to see our dependencies and examine emerging problems. We take a commodity and trace its intermediate use category and the quantities involved.

Again, this management is operating in a pseudo-strategic mode. At least management does not merely wait for stainless steel forgings or castings to become a problem, but tries to see anticipated problems in chrome within the lower tiers before they happen. However, unless management does something to reduce the problem in the lower tiers, it is still reactionary--merely reacting earlier than its more naive companions in other companies.

The materials manager went on to comment on what was done following the lower tiers review:

From this we develop a world resource plan. The plan includes an expanded narrative on strategic issues, such as on the Rhodesian embargo and what happened before and after. It also addresses the assumptions on which the plan is based. We look at mine production and scrap recovery programs over the world. From this we also break down company-wide consumption as to who it is that uses the material. We use an analysis grid that looks like this--

		Criticality of Material to Company		
Risk of Availability		High	Moderate	Low
	High	X	Y	
	Moderate	Z		
	Low			

The main focus of developing materials strategies is: with the materials of an X nature--high criticality and high risk. We focus our efforts there. Items with a Y or Z status have a high problem potential as well and will get secondary effort. We also do a matrix like this on criticality to the company versus price escalation risk

We also look at other industries and the competitive demand for the material over a five year time horizon as best we can approximate it. A good example is in our analysis of petroleum feedstocks. This gives us an econometric analysis of supply and demand industries for the material or resource. Such an industry profile,

for example, would include U.S. and Japanese industries dependent on a material. If Japan is an important user, what will the impact of our projections of their use have on the availability for the U.S.? We would look at the automobile industry as a competitive user of some materials that we use and predict the future impact of this industry on available supplies for us. We find that our company is almost 1-2 percent of a user of almost everything! The commodity manager specialists do it for our critical materials.

The materials planning effort in this company also includes forecasting of changes in manufacturing technologies that may influence the availability and prices of materials. However, a review of the materials planning document by the researchers revealed that it is largely a prescriptive planning document, and not an action-oriented proactive document. The document did not address, for example, planned changes in the source mix of materials or plans to develop new sources in response to constraints in supply. However, often materials managers did develop and implement proactive strategies, but these were not contained in formal strategic plans. As one materials manager commented:

We look at the major suppliers and get a quantitative and qualitative assessment of our strategic dependence. Where dependency problems occur, our commodity managers work out their own plans to deal with the problems. This does not appear in any materials resource plan but is an ad hoc management effort.

Review of materials plans in one company revealed the use of a strategic dependence profile for materials. This was reflected in the use of a construct shown on the next page as figure 69. This matrix relates the magnitude of a company's strategic dependence on a material to a risk profile of the supply industry. Issues used in determining the magnitude of strategic dependence were: (1) dollar volume of the material used, (2) criticality to the functioning of the system using the material,

Industry Profile of Risk	Magnigude of Strategic Dependence		
	High	Moderate	Low
High	X		
Moderate		Y	
Low			

Figure 69 : Matrix of strategic resource dependence and supply risk

(3) the trend and growth of use over the five year period, (4) the nonavailability of substitutes, (5) the concentration of uses relative to profitability and cash flow of programs, and (6) the forecasted ability to develop substitutes. Materials are then judged as to being a high, moderate, or low dependence material based on these factors.

The industry profile of risk addresses the political, economic, and social factors influencing supply industries down through lower tiers into such areas as castings and forgings. Management also looks at supply concentration, economics of production, capacity problems, expansion plans of suppliers, competitive uses of the material, and susceptibility to production or transportation curtailment as issues to assess supply risk. Sometimes the industry supply risk is also developed to a specific supplier. In one example, a company found that it was strategically dependent for 60 percent of a critical material on one supplier, and management did a risk profile on this supplier. The following are quotations from management regarding the use of this construct:

We found aluminum and cobalt were materials with a real problem to us. We have done a very detailed risk analysis on these and as a result our own aluminum materials plan was developed. It involves effort in a joint venture abroad to produce aluminum. We have a similar problem in bearings and have a large contract coming up for negotiation next year and are

now reviewing strategic plans of all bearing manufacturers and have found out that they do not have much planned. However, they have told us that they have decided to start looking at the kinds of questions we have been asking. We have found that we can be a successful expositor of management change in some companies when we point out these problems to them. When you are a major customer, you can do that. But, for example, we have low leverage in chrome, since we are only a small part of the demand for that.

This company had plans including joint ventures, programs for recovering scrap, and programs to develop substitutes--all based on assessment of strategic dependence and risk in supply industries. In its commercial products lines, the company management had identified a major casting as a target for cost reduction and had a materials plan working with a Japanese source to change the way castings were poured, machined and produced. This involved joint investment with the source to reduce costs on the casting.

Another materials manager made the following comment concerning strategic materials planning and conflicts with the government efforts:

Strategic planning in procurement is new to us. Our military operations have leaned on the government to do the materials planning. For example, the cobalt content of one of the major components in one of our systems is quite high. Nobody determines the size of the stockpile the government is building for cobalt. In fact we have found that while we are trying to buy strategic materials for our own stockpile, like cobalt, the government is building its own stockpile and making it even more scarce and driving the price up.

Our vice president of technology has also been active in trying to engineer out some strategic materials. However, some you can't engineer out--like tantalum. We have to have an assured supply. When a critical item is identified, we make plans for strict use of it in the company--only where it necessary and cannot be engineered out.

We also found that competition for titanium fasteners for use in campers and speedboats sent the price high and made the availability scarce. The company decided only to use titanium fasteners in high strength areas where a substitution of stainless steel fasteners could not do the job. We have substituted steel for titanium in several applications.

In the area of titanium, we looked at company-wide demand for it and went to our suppliers with a long term contract for it to cover several hundred uses that we could not make substitutes for, and this has helped us in availability and price.

In some instances the researchers found that materials planning was not limited to just the materials management function, but it was a coordinated program through several functional groups. The manufacturing council in one company had a key role, and in another company there was a laboratory under the engineering department that worked on critical materials problems, focusing on substitution. There were no combined materials strategy plans, but each department examined materials problems from its own perspective--materials management from a source relationships perspective, manufacturing from a value analysis and materials recovery perspective, and engineering from a substitution perspective.

One company indicated that it had a long term critical materials identification that extended through 1984 and a listing of such materials together with volume forecasts were given to suppliers of critical items to assist the supplier in his own planning. In this case the company was able to get some suppliers to extend capacities to meet these volume requirements without termination liability because of the size of the customer.

As indicated earlier, not only materials but also processes must be included in planning. One company told the researchers that an independent consulting firm had studied its requirements and indicated that it would become more dependent on outside subcontract manufacture because of the design processes which it planned. This increased outside dependence became a strategic issue and resulted in funding proposals for increased development of in-house capabilities to protect it from vulnerability from outside manufacturing becoming more than 50 percent of its value added.

Critical Materials Programs

The purpose of this section is to present indepth material on specific critical materials programs being used by DOD contractors focusing on strategic materials and entrepreneurial efforts at strategic materials identification. According to one company, strategic materials planning involves:

- (1) Strategic studies of material availability and price trends (information subsystem).
- (2) Analysis of materials potential impact on the firm. (decision and information subsystems).
- (3) Development of strategic plans to minimize adverse impacts and capitalize on opportunities (decision and action subsystems).
- (4) Implementation, feedback and continuous monitoring of plans (action subsystem).

In determining criticality of materials, two different approaches have already been presented earlier in this chapter. A third approach found in the study uses a criticality grid. This grid has two axes of criticality--internal and external. The grid uses the nine cell matrix typified by the General Electric strategic planning model as did the previous two methods discussed. However, it spells out issues of criticality in a different manner. These are:

Issues of Internal Criticality

- Percent of product cost
- Percent of total purchased materials costs
- Commonality to a variety of products produced
- Degree of substitutability
- Profit impact

Issues of External Criticality

- Numbers of primary/secondary sources
- Availability of supplier stocks
- Supplier cost, price, profit trends
- Possible legislative impacts
- Supply industry capacity and productivity
- Availability of substitutes

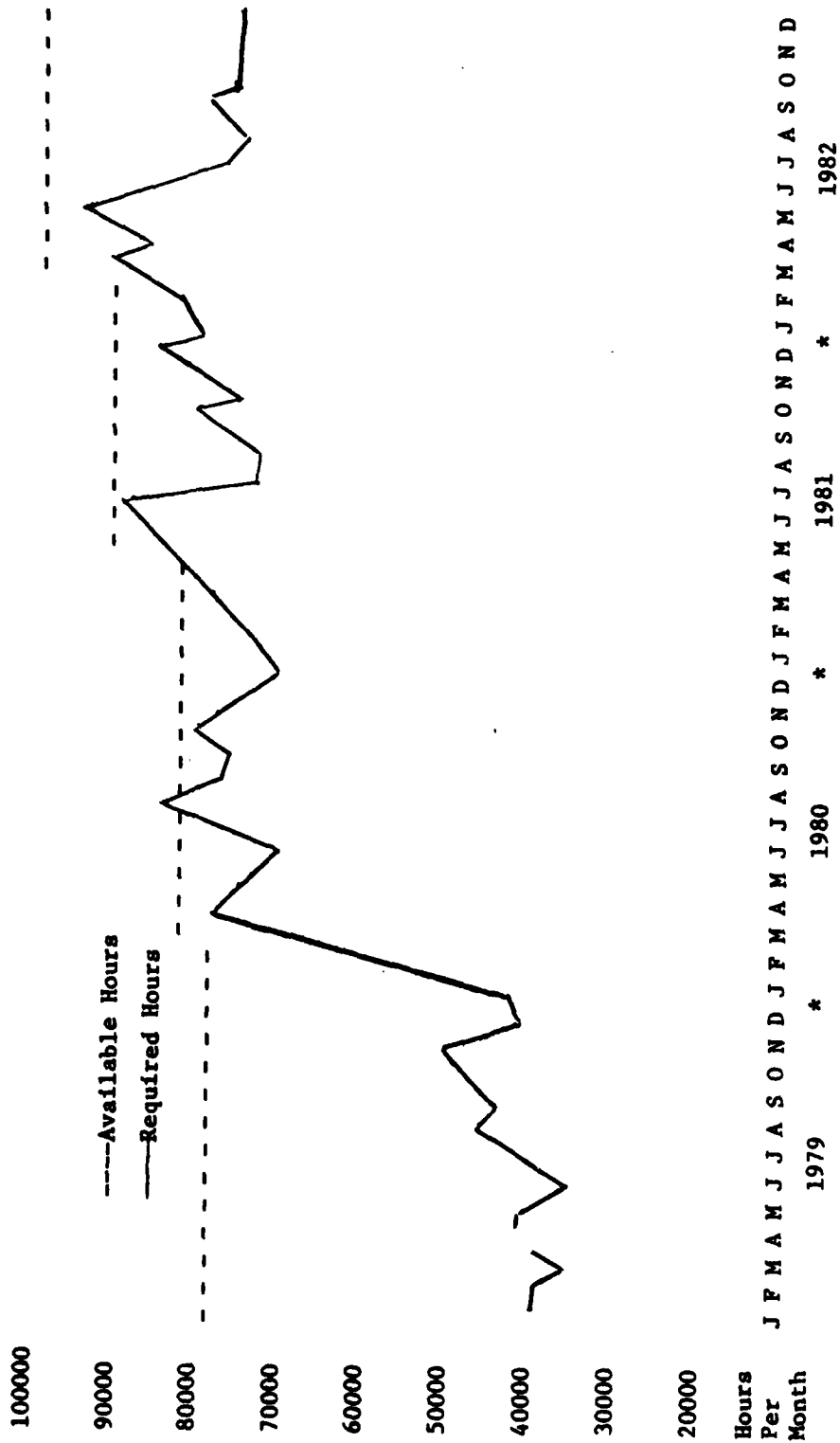


Figure 70 : Available and required machining hours for a four year forecast.

The materials criticality program then addresses specific materials and examines these issues to complete Phase I or materials screening for criticality. Phase II involves risk assessment, Phase III strategy development, and Phase IV implementation programs. Risk assessment involves determining capabilities to deal with criticality issues and the vulnerability of the buyer to these issues. Wherein adequate responses can be determined, strategy development does not occur--for example, this may mean merely getting another source. Where this cannot occur, a specific long-range strategy is developed. Implementation programs establish linked steps to carry out these strategies.

Phase I screening involves information to determine criticality issues for specific materials, such as capacity availability and required hours. Figure 70 illustrates one example of information used in determining criticality by contrasting available hours with required hours in a machining industry over a time horizon of four years to determine where, if any, problems will occur. This example shows that planned expansion in capacity will occur as demand increases occur and the slope of the requirements line is matched very well with planned expansion of capacity.

Figures 71 , 72 , 73 , 74 , and 75 illustrate examples of supply industry reports for specific materials which were provided to the researchers by one DOD contractor. These are summary reports on specific component industries. On Figure 71 the user industry is electronic parts and components in general, and the specific commodity being acquired is miniature ball bearings. The industry study shows class of bearings and average leadtimes, together with comments indicating the dynamics of supply and demand. A similar summary is shown for integrated circuits, transistors and diodes, tantalum capacitors, and aluminum. These profiles were contained in strategic materials plans as a basis for diagnosing specific problem issues.

User Industry Doing the Forecast of Demand Needs: *
Electronic Parts and Components

Commodity: Precision miniature ball bearings

Current Usage Lead Times:

<u>Class</u>	<u>Lead Times (Average)</u>
ABEC 1	32-38 weeks
ABEC 2	26-30 weeks
ABEC 3	20-26 weeks
ABEC 4	20-26 weeks
Specials	50 weeks plus

Comments:

- 1) Medical, dental and consumer markets have all increased demand
- 2) Relatively small increase in capacity during recent years
- 3) Industry capacity concentrated in four companies
 - New Hampshire Ball Bearing
 - Miniature Precision Bearing
 - Barden Corporation
 - Nippon Miniature Bearing

Figure 71 : Critical Materials information for miniature ball bearings

*Refers to the industry making the forecast of demand/supply problems with information following colon referring to commodity class.

User Industry Doing the Forecast of Demand Needs:
Electronic Parts and Components

Commodity: Integrated circuits

Current Average Leadtimes:

<u>Classification</u>	<u>Lead Times (Average)</u>
Low power schottky	30-52 weeks
TTL product	22-50 weeks
Selected memory product	28-42 weeks

Comments:

- 1) Motorola, TI, Fairchild, Signetics, AMD and other leaders all operating on allocation programs for low power schottky
- 2) Several companies have capacity booked into 1981 and are not accepting orders from new customers.
- 3) Most of the leaders have converted to four inch wafers but cannot meet demand
- 4) Future improvements not in evidence. The high cost of capital equipment in the industry forces suppliers to approach expansion with caution. Expansion is taking place, but is being aligned toward new high technology areas, e.g. microprocessors, high-intensity negative channel metal oxide semiconductor, large scale integrated circuits.
- 5) On TTL products, plastic product currently more critical than ceramic and MIL product. Future improvement doubtful. No facilities expansion expected due to allocation of available capital to high technology products.

Figure 72 : Critical Materials information for integrated circuits

User Industry Doing the Forecast of Demand Needs
Electronic Parts and Components

Commodity: Tantalum Capacitors

Current Average Leadtimes: 16-30 weeks

Comments:

- 1) Few major suppliers; and solid allocation program
- 2) Notwithstanding dramatic price increases due to sky-rocketing price of tantalum ore and powder, demand remains at record high levels
- 3) Substantial expansion has been effected
- 4) Concern is the continued supply of ore and powder. The ore is allegedly controlled by a European cartel, and there are only three manufacturers of powder with limited capacity. Certain powders are currently in short supply.

Figure 73 : Critical Materials information on tantalum capacitors

User Industry Doing the Forecast of Demand Needs:
Electronic Parts and Components

Commodity: Transistors and diodes

Comments:

Forecasted problems are:

Not a serious problem at this time, but could develop into a major obstacle. A rapid increase in automotive sales could impact capacity especially on certain high demand devices.

Metal can transistors would present a major problem in case of a large scale armament program. Mandatory use in military applications. Most suppliers have discontinued due to declining demand and increased material costs. There are currently only four viable sources of supply left and one of these has started a phase out action.

Heavy increase in defense requirements (surge) would create temporary extended lead times and supply problems on certain items. The industry does not have sufficient burn-in racks and test equipment at this time to support major increase in demand.

Figure 74 : Critical Materials information for transistors and diodes

User Industry Doing Forecast of Demand Needs:
(Airframe)

Electronic Parts and Components

Commodity: Aluminum

Sheet and plate	Current Average Lead Times
Standard sheet	10 weeks
Standard plate	48 weeks
Nonstandart plate	80 weeks
Extrusions	
Small	24 weeks
Intermediate/large press	60 weeks

Comments:

- 1) The major suppliers are limited to ALCOA, Reynolds, Kaiser
- 2) Lead times are impacted more by the availability of processing and fabrication capacity rather than supply of basic metal. The following is information relative to capacity expansions which was provided by producers--

Alcoa: \$70 million added in 1978
Increased plate heat-treating facilities, on line first quarter 1982
Continuous casting and cold rolling mill additions
Expanded rolling facilities
New sheet mill
Approximately \$200 million plate mill expansion on line first quarter 1982

Reynolds: New continuous casting and cold rolling plant
\$70 million sheet and plate expansion complete
New plate head-treating on line first quarter 1981

Kaiser: \$200 million modernization of aluminum sheet facilities

Figure 75 : Critical Materials information for aluminum

Reports also included general, unclassified information about supply industries. Examples found in materials plans included the following issues:

- (1) The U.S. is increasingly becoming an importer of raw materials
- (2) So called Third World countries supply the advanced industrialized countries with metals, minerals, and petroleum
- (3) While deep sea mining affords new supplies, ocean floor mining of minerals has been practically eliminated for the balance of this century.
- (4) Uncertain legal environment causes projects not to be "bankable" on world capital markets.
- (5) Government regulations can cause unpredictable demand spikes, such as for catalytic converters demanding platinum.
- (6) Capital requirements for mining and refining are extremely high and integrated coper facilities are typically \$1 billion in investment--aluminum smelters \$100 million and up.

This type of information provides an environmental base for examining resource problems in the strategic plan. Another strategic materials plan shown to the researchers had the following information concerning recommended actions by the government and by contractors to increase the availability of resources:

- (1) Increased standardization of specifications
- (2) Providing drawings for spares to DOD earlier to have more reasonable leadtimes.
- (3) Reduction of administrative interference in a company's business practice.
- (4) Government recognition of the fact that the loss on one program must be made up in profits on another.
- (5) Complete and accurate information should be available at the start of a program.
- (6) Filtering out subcontract terms and conditions that are not absolutely required for flow-down.
- (7) Permitting recovery of investment of R&D costs made by the contractor.

Whereas most of these items are typical rhetorical complaints, the documents provided some specific discussion of how they were hindering the

process of strategic management of resource acquisitions. Specific studies of lower tier industries showed the following kinds of strategic issues relative to the long-range health and vitality of the lower tier segments:

- (1) Off-shore assembly of most components will increase, with many being assembled in the Far East, subject to potential supply interruption with no significant U.S. backup capability.
- (2) Declining interest in military business due to companies having a perceived difficulty in dealing with the government versus commercial customers in areas of--
 - nonstandard specifications
 - Slow and uncertain placement of orders
 - Consumption of more billing resources per dollar
 - Smaller production runs
 - Bureaucratic contracting procedures
- (3) Long payout for major program investments and a need for cost sharing on redesign.
- (4) Lengthy qualification and requalification procedures discourages design improvements and equipment upgrades. This leads to obsolete technologies, parts, and manufacturing capabilities.

The strategic materials report in this company went on to make the following recommendations to the government with respect to the supply of semi-conductors:

- (1) Establishment of a significant U.S. based production capability through the next decade.
- (2) Mandating of 100 percent domestic production of semi-conductors for all new programs starting in 1981, and all procurements effective January 1984.
- (3) Domestic production of critical piece parts should be mandatory. Most ceramic packages and lead-frames are supplied by Japan. This recommendation would require government funding and subsidy to establish U.S. production.

- (4) Simplify component specifications and contracting procedures with incentives for designs using standard parts. New guidelines in trade-off of technology and performance versus parts availability.
- (5) Specify as close to commercial components as possible.
- (6) Simplify qualification and requalification to encourage component and equipment upgrades, change for areas of critical materials, cost reduction designs to remove expensive materials, productivity improvements, and production automation.
- (7) Improve profitability of military business with cost plus instead of cost sharing for design programs, progress payments, and continuous production contracts.

Figure 76 provides an example of a more complex critical component and material evaluation procedure used by an contractor company. The issues to determine criticality are: number and types of user products, business significance of these products, other criticality rationale, component/product cost ratio, and annual component volume/cost for three years. Based on a summation of these issue criteria, the company ranks components and materials as the basis for prioritizing actions in resource acquisitions.

In another study of resource markets, a contractor consolidated various sizes and shapes of aluminum into twenty four family groups and requested suppliers to state current leadtimes plus estimates through three years in the future. The company was told by the suppliers that all customers were on allocation based on 1978 purchases and the contractor's current military and government programs had no mill allocation established since it was not yet funded for production. The company subsequently placed a commitment and received an allocation, although it did not yet have a government contract. As a result of this situation, the company did a major study of its supply support and came up with the following recommendations for supply assurance:

Critical Component/Material	Critical Components Summary Format				Other Rationale for Criticality
	User Products	Business Significance	Component/Product Cost Ratio	Annual Component Volume/Cost 1979 1980 1981	
Magnetic Heads					
Ferrite Gap Bars					
Motors; DC Servo					
Capstan Motors					
HV Transformers					
Galvos					

Figure 76 : Example of critical component/material summary format

- (1) Release all forgings and extrusions for immediate buy even though there is not a signed contract for a major government program.
- (2) Buy all bar and plate available at distributors and stockpile
- (3) Input new leadtimes to the computer for all items
- (4) Requisitions to be released for critical items to make the lead times regardless of contract status
- (5) Acceleration of buying metallic materials by approximately one year.

These proactive, risk-taking efforts were not typical of most contractors, however.

Figure 77 illustrates an example of a raw material (disguised) forecast used by a company indicating new lead time commitments, planned commitments, and expenditures for the raw material through a four year planning horizon. New lead time commitments represent the problems which management expects to face and the leadtime necessary to make contractual commitment to assure on-time delivery. Planned commitments represent those normally used for delivery, with the difference between this and new leadtime commitments representing the risk bearing of the company to assure on-time delivery. Expenditures represent the line when the company expected to get funding from the government.

Material Effectiveness Intra-Company Objective Program

One contractor's program for critical materials management was thorough and innovative enough to deserve more detailed mention in this report. This section reports the findings of the authors concerning the "Material Effectiveness Intra-Company Objective Program (MEICO)" used by a large electronics contractor of DOD. The purpose of the program, according to company statements, is to get more intergroup communication and to assure worldwide material effectiveness within the company.

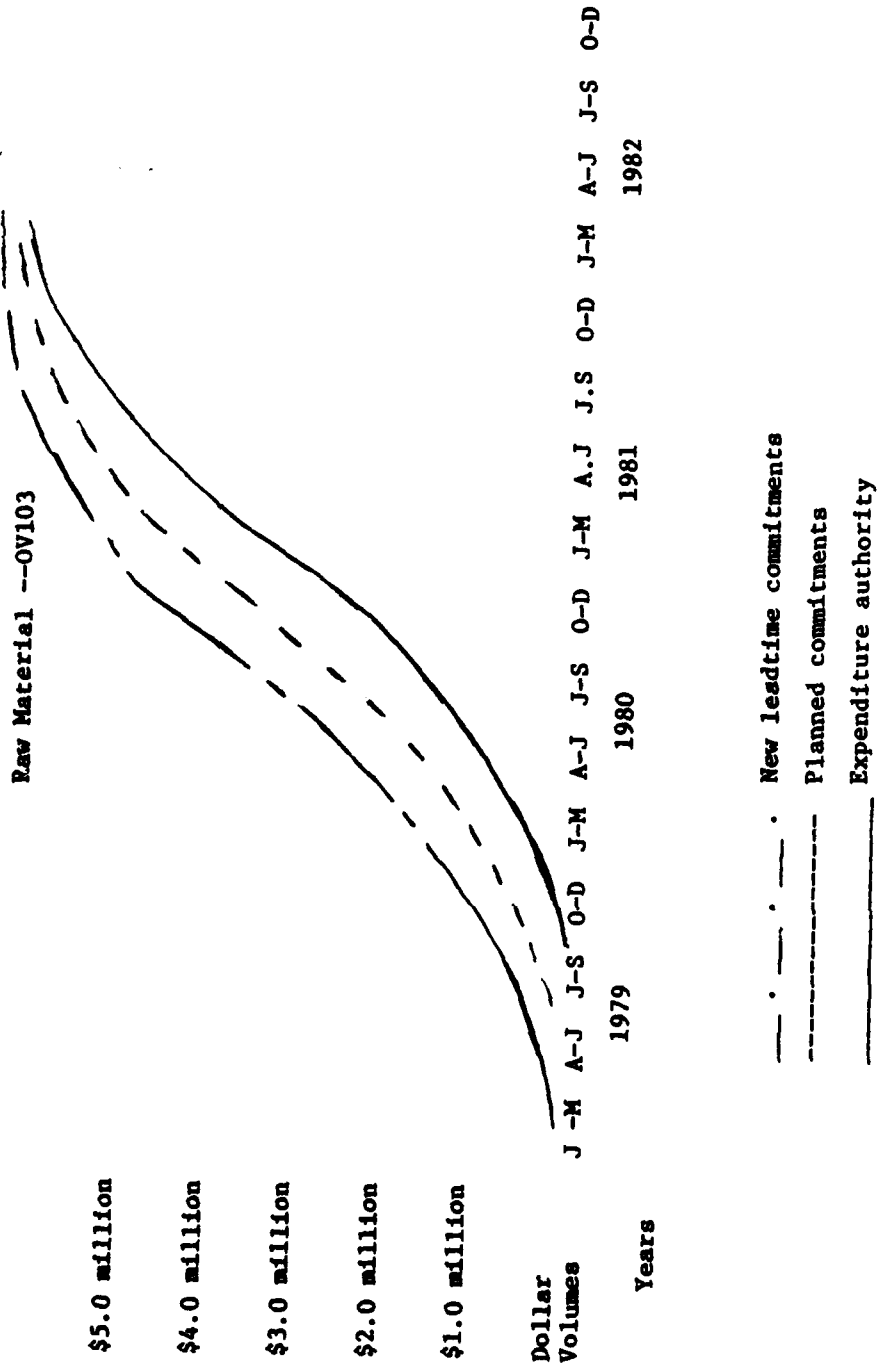


Figure 77: Raw material leadtime commitments plan

A committee headed the MEICO program and was charged with the responsibility to develop materials strategies for worldwide sourcing. The committee included a diverse membership within the company, including legal and facilities personnel, and issues addressed by the committee in this program were:

- Increased standardization across the company
- Use of company purchasing agreements
- Vendor performance effort evaluations
- Small and minority business programs
- Major traffic programs and periodic purchasing audits

The organization also included inputs from the U.S. purchasing managers committee for the company, and a separate committee on corporate standardization. One important committee interfacing with MEICO was also the "critical materials committee," charged with the responsibility to review and list critical materials with company vulnerability, review current source positions and their disadvantages, and review cartel actions and political sanctions. The result of these reviews was the statement of long-term strategies to deal with them.

The MEICO charter was also to include a ten-year perspective and supply outlook for the company. Phase I of this program had begun at the time this research (interviews for this report) was conducted by the authors. This phase identified the materials and the suppliers involved. Phase II had begun and it determined the criticality using a sensitivity index shown in Figure .

The MEICO group established resource market descriptors and used them in determining critical material sensitivity. Eight descriptor factors were used, based on the combined effort of all procurement managers in assessing these factors. The total summation of the factors provided a sensitivity or criticality index for the item. However, the focus of the index was on assessment of current not future judgments of the descriptors. That is, the index merely showed the present vulnerability and criticality, with no indication as to future emerging problems or changes.

Descriptors

Application of Descriptors

S	P	C	F	BP	SS	N/S	MOB	Rank	Material	S	P	C	F	B/P	SS	N/S	MOB	Total
Total supply available in world and U.S.	Geopolitical source region politically unstable	Cartel controlled, short-term price dislocations	Refining/fabrication capacity	Byproduct of another material, subject to disruption	Sole source	Not readily available substitute	Critical in event of mobilization	1	Cobalt	5	9	9	7	2	7	4	10	6.5
								2	Chrome	5	8	7	5	2	5	5	9	5.8
								3	Manganese	6	7	6	5	3	6	7	8	5.7
								4	Palladium						etc.			
								5	Petrochem.						etc.			
								-										
								-										
								10	Tantalum	6	4	4	4	5	4	5	8	4.9

Least = 1

Most = 10

Numbers assigned according to judgment of sensitivity to that descriptor, on scale of 1 not sensitive to 10 sensitive.

Items listed in order of criticality to this company cobalt #1 to Tantalum #10. Other critical materials included were chrome, manganese, palladium, petrochemicals, platinum, molybdenum, oil and gas, rare earths. The listing also included additional items beyond 10 including solvents, acids, plastics, germanium, nickel, salium, selenium, silicon, quartz, and aluminum

Figure 78 : Application of MEICO criticality descriptors and materials rankings.

In addition to the descriptors listing shown in Figure 78 , the MEICO committee also developed a critical materials ten year outlook for the company, in the format shown below:

<u>Commodity</u>	Three Year Outlook	Ten Year Outlook	Company Producer Position
Aluminum	Tight	Tight	Tight, Alcoa, Reynolds, Southwire, Conalco all that are available.
Cobalt	Unstable	Unstable	No capability externally
Cobalt	Tight	Tight	No capability except through specialty steel producers.
Chrome	Tight	OK	No, steel producers should improve
Molybdenum	OK	OK	No, except through specialty steel producers
Manganese	OK	OK	No, through specialty steel producers
Zinc	OK	OK	Through brass mills

This company also implemented recommendations for the critical materials in terms of a specific strategy. For example, the following information was extracted from a MEICO recommendation document:

Cobalt: Internal use by four groups, used in alloys, magnets. 1980 quantity 15,000. In 1990 10,000. Sources are Cartech and Allegheny. Recommend we stockpile one year usage at \$300,000.

Chrome: Internal use by one group. Used in tool steels. 1980 quantity 2000K units, 1990 to 4000K units. Sources crucible, Allegheny, Instel. Recommend maintain long-term contracts and top management dialog with suppliers. Use DX/DO ratings.

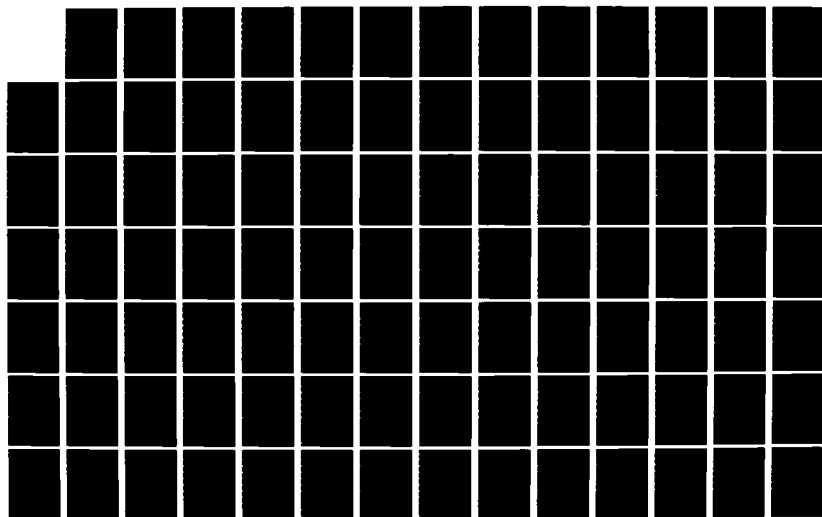
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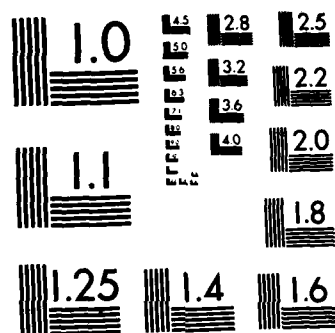
STRATEGIC MANAGEMENT OF RESOURCE MARKETS: AN
EXPLORATORY STUDY OF DEPARTM. (U) NAVY CENTER FOR
ACQUISITION RESEARCH MONTEREY CA R L SCHILL ET AL.
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MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

MEICO MATERIALS COMMITTEE ANALYSIS

Material: Cobalt (Co)

Sources: Zaïre, New Caledonia, Soviet Union, Philippines, Cuba, Zambia, Australia.
Mostly refined by SGM, Hoboken, Belgium.

Outlook: Supply controlled by SGM cartel and Soviet Union. The U.S. mined were shut down, but now are being reactivated. Australia and Canada have increased output as a byproduct of nickel production.

Use: Projects and end products using Cobalt were listed in this section. Left out in this report at request of the company

Forecast: 1980 1983 1990

Volume in pounds given (left out in this report at request of the company)

Sources to be used: Cartech (F-15), various lead frame and eyelet stampers, tool steel
Crucible, Cartech, AL special alloys.

Recommendations: Purchase and stockpile one year's usage of refined Cobalt at \$300,000.
Make available to metal converters for our exclusive use in the event of an emergency in supply.

Figure 79 : Example of MEICO materials analysis and recommendations.

MEICO Summary of Critical Material Sensitivities

<u>Materials</u>	<u>Descriptors and Judgments</u>								<u>Total</u>	<u>Index</u>
	S	P	C	F	BP	SS	N/S	MOB		
Silver	2	1	6	3	2	1	5	2	22	2.6
Gold	1	5	6	1	1	1	6	3	24	3.0
--										
--										
Molybdenum	--	--								
--										
--										
Solvents	--									
Selenium										
--										

Some 27 materials listed with totals and index. Total represents the sum of all descriptors whereas index represents the total divided by the number of descriptors or the average score.

Figure 80 : Listing of MEICO materials with application of sensitivity index.

The authors studied minutes of past MEICO meetings and discovered the following agenda items that were discussed:

- (1) Review of prime contractor corporate procurement policy
- (2) Presentation by divisional personnel on their organization and their business environment
- (3) Major program overviews, including quality requirements
- (4) Vendor awards for the top ten vendors for year.
- (5) Quality performance schedules
- (6) Future plans

The MEICO group selected the top ten vendors of the company each year and made a presentation to them based on several criteria for selection.

Furthermore, the MEICO committee also served to meet the following objectives, listed in its charter:

- * Develop uniform and comprehensive training programs
- * Increase of combined buying power of the company
- * Maximize intracompany purchases
- * Coordinate small and minority purchasing programs
- * Disseminate vendor information
- * Improvement of standardization in purchasing systems
- * Uniform job descriptions and ethics policies
- * Buyer development and measurement
- * Promotion of standardization of materials
- * Functioning as a communication channel for strategic issues

Finally, in terms of plans for the future, the company listed the following goals developed by the MEICO organization: (1) More long term contracts, (2) more work on standardization, (3) more work on alternative sources, and (4) more use of make versus buy analysis.

Staff Studies and White Papers

Most companies studied had relatively undeveloped strategic management of the procurement function. When compared with the strategic planning of marketing operations, on a scale of 1 to 10, the application of techniques in marketing-oriented strategic planning among the firms surveyed, in the view of the authors, would be about a 6. The application to the procurement function would be a 2.

Most materials strategic planning is being done by staff studies and white papers focusing on specific problems, rather than through annual strategic plans. This section addresses what is being done in the form of staff studies of materials issues.

The following extensive quotation came from a materials strategy whitepaper given to the researchers by one of the companies studied. It is quite representative of the kinds of emerging issues about materials strategies, although it does a somewhat better job of articulating the issues than most companies were able to do.

As we enter the 1980s, we have decided that it will be mandatory for us to have an in-depth understanding of the material market place with respect to our ability to fulfill our contractual requirements to our customers. Uppermost in our minds is cost, schedule and quality compliance, with quality usually a function of cost and schedule pressures.

However, two factors dominate today's material world and are the subject of most of our materials strategy effort: inflation and diminished sources and suppliers.

In the area of inflation, during 1979 we experienced general price increases of 1-1 1/2 percent per month, with some items going 30 percent and one as high as 253 percent in the span of one year. We expect such price escalation pressure to continue. Primary metals, chemicals, petrochemicals, paper, castings, forgings and most all fuel will undoubtedly continue an upward spiral.

The ability to accurately forecast the price increases has been poor, yet we continually see suppliers sending us the memos "all billings will be at the prices current at the time of delivery." In the electronics piece part arena, the world market on precious metals is in such a state that all major suppliers have developed formulae that buyers must comply with in order to determine the price at the time of delivery. In some cases they have been applied retroactively. This is a major problem, because in 1979 materials represented over 34 percent of sales.

Availability of materials, or lack of materials, is an increasing problem due to many factors. Aluminum production for 1980 has been cut back severely due to power shortages in the Pacific Northwest, as well as required refurbishment of some of the older rolling mills. This shortfall has increased lead times for milled aluminum sheet to 72 to 96 weeks on some alloys and sizes.

Four factors discourage expansion of aluminum smelting in the U.S.: Energy supplies are unpredictable and costly, profits are too low to justify expansions, environmental restrictions make it expensive, and higher operating costs provide poor economics.

This leads us to the conclusion that aluminum capacities will remain a problem over the next several years.

Stainless steel is feeling a pinch in availability of exotic alloys needed in our industry. The basic steel industry is weakened by foreign competition. In other metals government regulations have forced many companies to go overseas for smelting rather than comply with regulations. Expansion of processing capabilities is hindered in many metals. In some metals we have access to the raw material, but no capabilities to increase capacities, whereas in other metals there is a shortage or concern over the availability of the raw materials.

The Soviet Union has stopped exporting titanium sponge. Great Britain shut down its only processing facility for it, and Japan is producing only for itself. The People's Republic of China has titanium sponge, ingot, sheet, plate and extrusions available for export up to 500 tons per year, but unfortunately it is not up to aerospace quality. We intend to import sponge processed in accordance with the right specifications, and much of the metal we can get will not meet the government requirement under DAR 7-104.93.

The year of 1980 will be a sink or swim year for many small suppliers. High interest rates, strict lending policies and a morass of confusing and costly regulations have already caused the closing of many important suppliers. Demands for front money, not all of which can be met, are on the increase. We have seen a dramatic decrease in small hydraulic specialty shops and precision machine shops. Those shops still in existence are overloaded or will not accept work beyond that they have. Many artisans have died or retired and training of new ones is poor.

The 1960s saw an anti-establishment trend which has meant communal, hippy living. To become an apprentice and learn a trade was unthinkable. The results of this attitude are now being felt in the industries. Most forging shops are specialty shops where skilled personnel are needed. There is a serious shortage of machine milling and large aluminum sheet and plate. All large skin mills have been booked for two years.

All of this has been aggravated by U.S. government's insistence through Public Law that we buy more and more from small and minority businesses. This must occur even though their path to extinction is pretty well defined.

The foregoing leads us to the following inescapable conclusions:

- (1) Some raw materials are going to get more scarce than ever before and almost impossible to obtain.
- (2) Prices will continue to go higher and higher.
- (3) Lead times for most basic materials are going to continue to increase.
- (4) We must know what alternatives are available to use before we find we are in an inescapable problem and cannot get our requirements.
- (5) Existing management philosophy and policies in acquisition are not tuned to the implications of reality. Revisions of existing practices must occur.
- (6) We need an approach to new proposals and prime contract negotiations with a plan that recognizes the continuing instability of the materials market place, but the cost and schedule should be negotiated so we are not losing the game.

The authors found staff studies and white papers in the following areas among the companies surveyed with the recommendations shown:

Inventory Turnover

Improve inventory systems, stock controls, supplier owned inventories, improved forecasting, integrated requirements.

International Offset

Improvement of intergrated planning, establishment of offset in corporate planning, development of foreign capabilities, and centralization of controls on offset commitments.

Materials Management Training

Develop integrated training plans, initiate corporate seminars, and recruit materials management interns.

Cash Flow

Scheduling of deliveries, payment provisions, improved customer funding, reduction of inventories, and receipt of usage time.

Leadtimes

Advance planning, funding, multiple sourcing, reduced recycle time, and improvement in expediting.

Manpower and Volumes

Improved systems, combined procurements, training, and recruiting of personnel.

Inflation

Increased competition, multiple source development, negotiation training, value analysis, and standardization.

Government Regulations

Improve systems, training, industry association activities, and congressional/agency discussions

One company supplied the material in Figure 81 illustrating an historic and forecasted trend between sales levels and commitments to procurements as a percent of sales, showing the workload of procurement management through 1987.

Another study about the semiconductor market provided an in-depth analysis of this market from a supply and demand perspective. The study was done by an outside firm specializing in this industry. It showed that the semiconductor market would grow to \$43 billion by 1987 and that the military share then would only be \$1.4 billion, a substantial loss in share and power in the market. The military market would be down some 7 percent since 1978. Specific semiconductor problems were expected to occur, including the following by 1987:

- (1) Personnel scarcity and lower skills
- (2) Limited number of top notch engineers
- (3) Silicon Valley shortages in factory people and land zoning.
- (4) Increasingly expensive capital equipment.
- (5) Increased industry concentration and vertical integration.

These problems become identified strategic challenges for resource market planning. The company can either consider them as constraints and plan around them or develop proactive solutions to them. Since most are industry-oriented and broad, in this case constraint management would seem most appropriate.

CORPORATE MATERIALS STRATEGIC PLANS Sales and Commitment Ratios

Dollars
Left
Blank at
Request of
Company

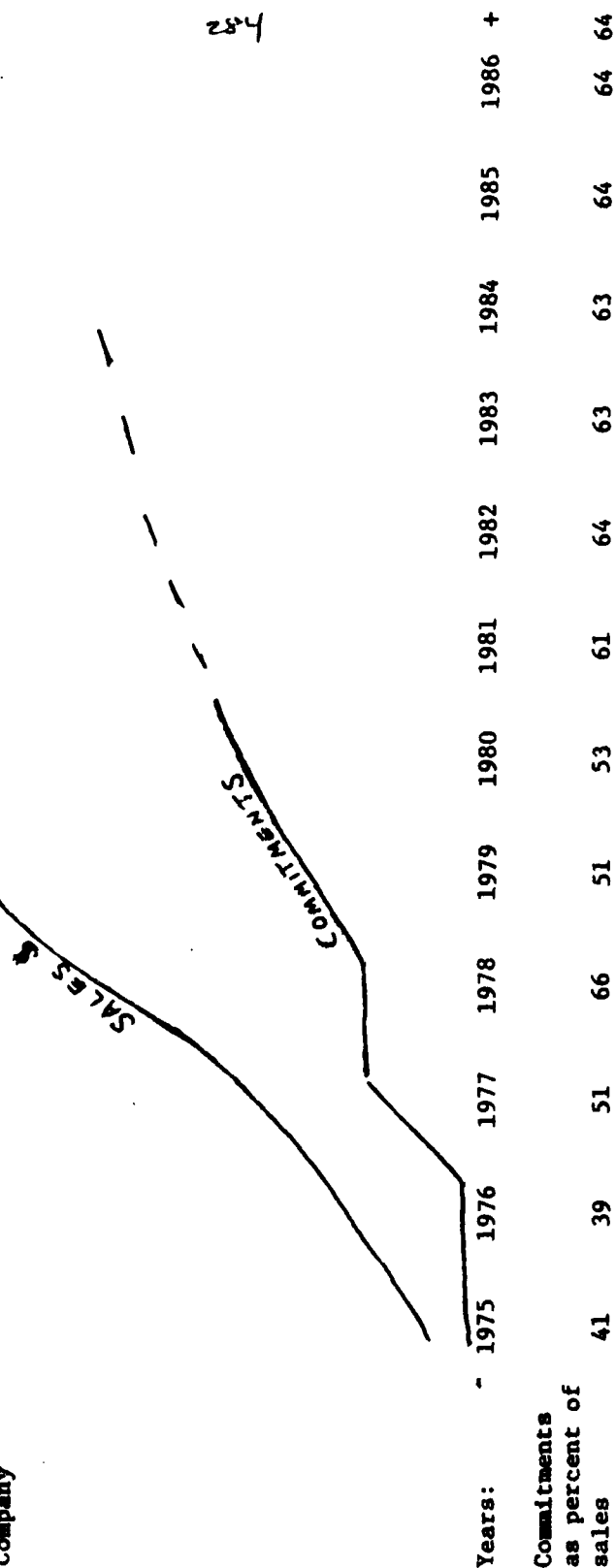


Figure 81: Corporate materials strategic plans--sales and commitment ratios

Finally, one company supplied what it termed its index of lead times and price changes for specific commodities on the basis of 1976 as the base year. These are shown in Figure 82 .

Economic Trend Indexes											
	Lead Time in Weeks					Price Change %					
	20	15	10	5	0	0	5	10	15	20	
Steel (Low carbon, cold finished bar)			*13			1980		9*			
			12			1981		8			
			12			1982		10			
Zinc (die casting alloy)				*6		1980	5*				
				6		1981		10			
				6		1982		10			
Aluminum (RSI Ingot)			*8			1980		10*			
			12			1981				17	
			12			1982				15	
Custom Machined (Precision Parts)			*12			1980		8*			
			10			1981	5				
			10			1982	5				
Custom Die Castings (Al Alloy 360/380)		*18				1980		9*			
		16				1981		7			
		16				1982		9			
Industrial Fasteners	*20					1980				11*	
	20					1981				10	
	20					1982		9			

Figure 82 : Examples of lead time and price forecasts for three years.

U. S. SHEET AND PLATE CAPACITY AND UTILIZATION

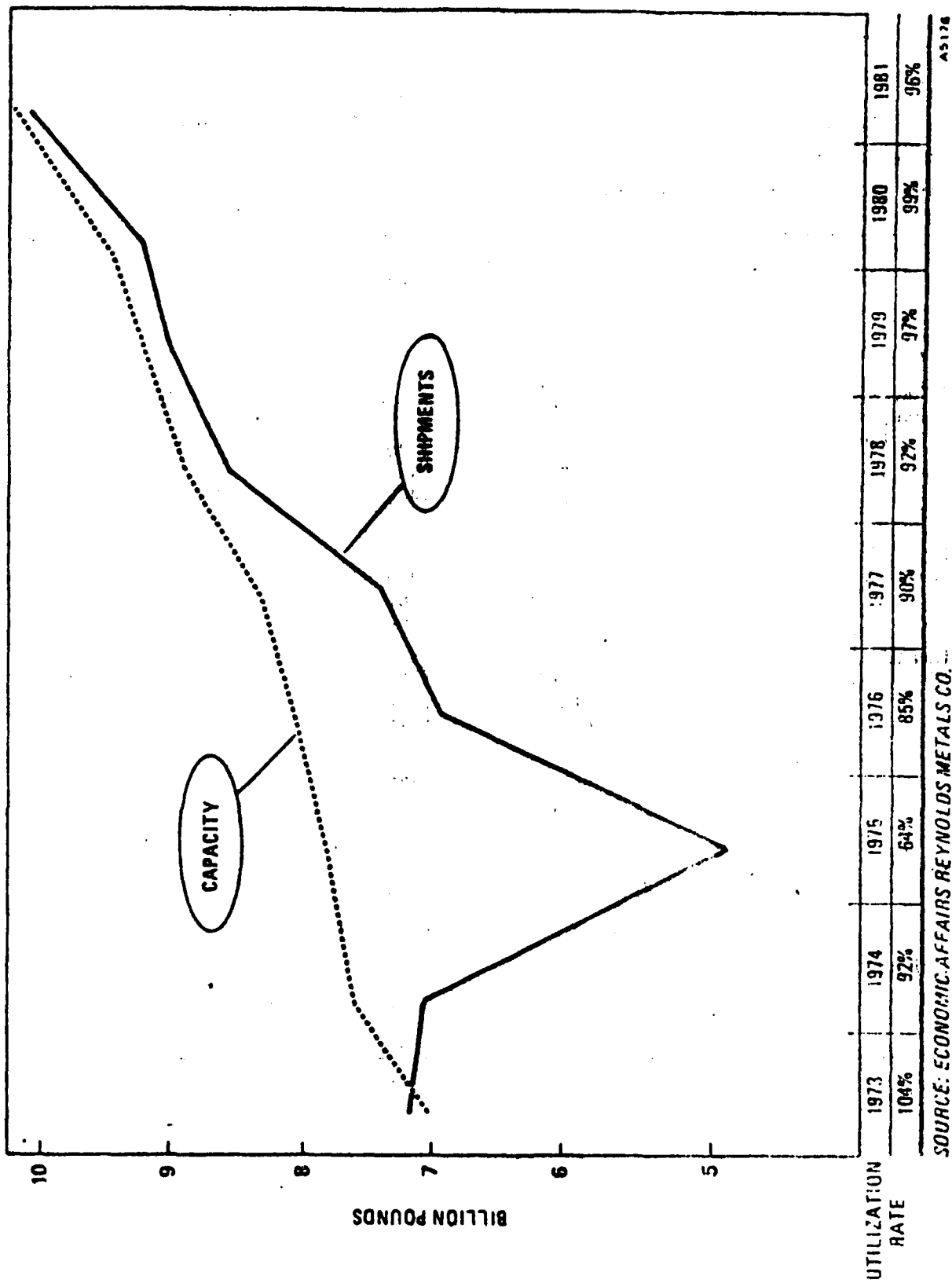


Figure 83 : Capacity and Utilization for U.S. Sheet and Plate

ELECTRICAL/ELECTRONIC LEAD TIMES

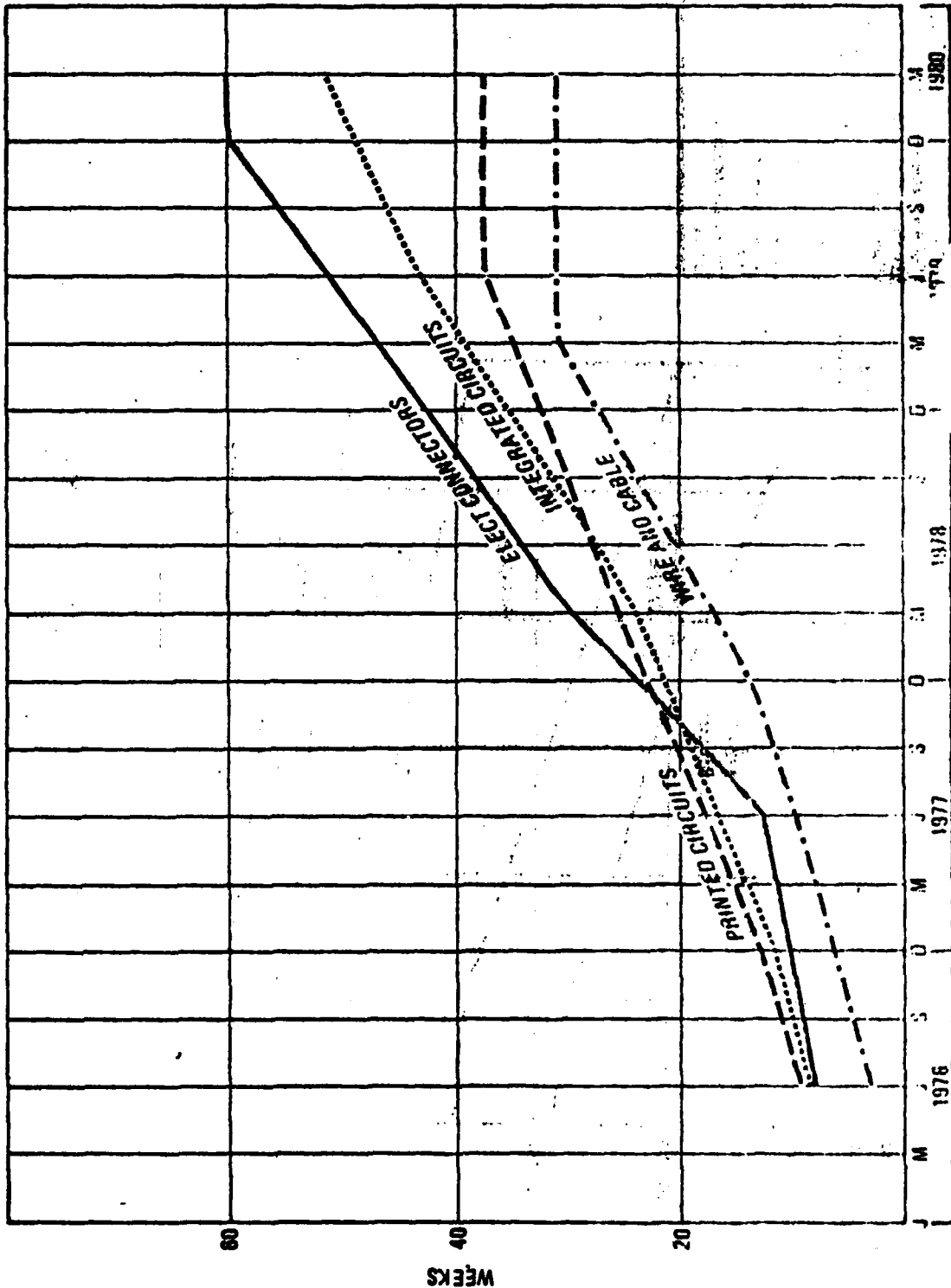


Figure 84 :Analysis of leadtimes for selected electronic compon s

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U.S. ELECTRONIC EQUIPMENT PRODUCTION IN 1979

\$78.527 BILLION

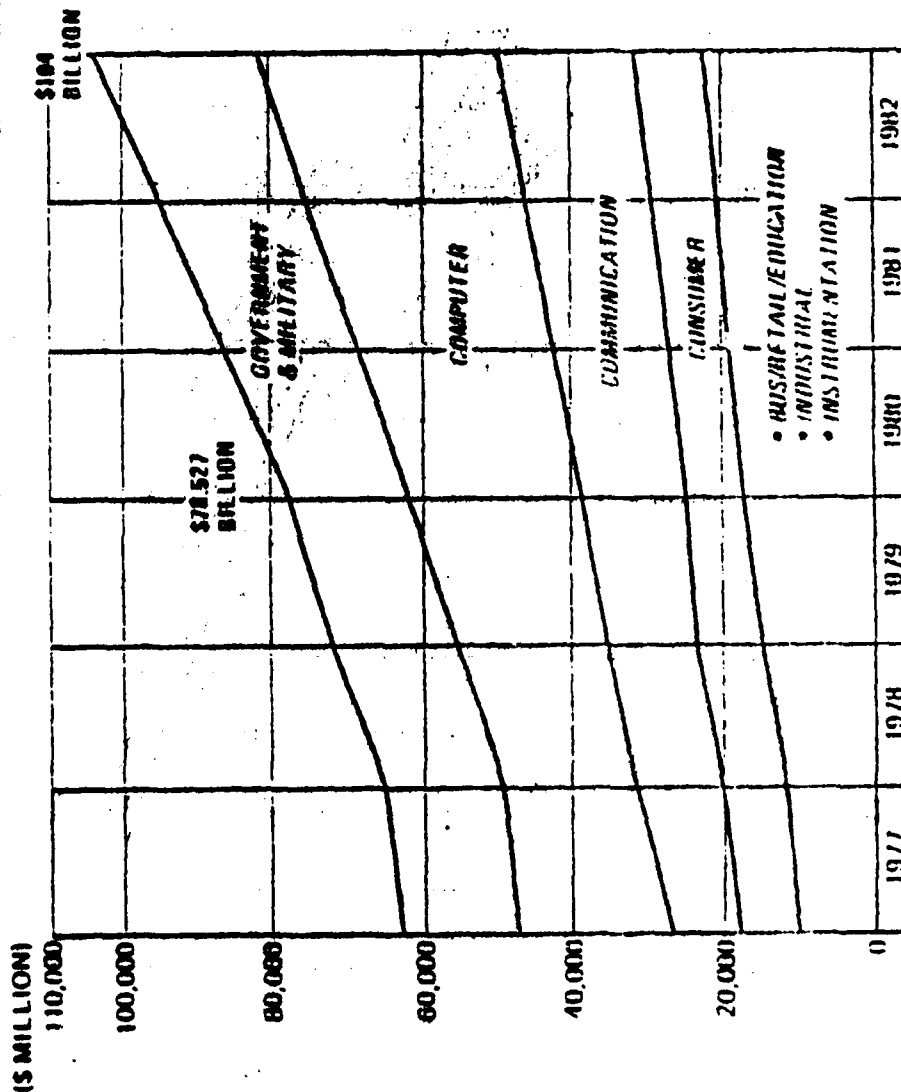
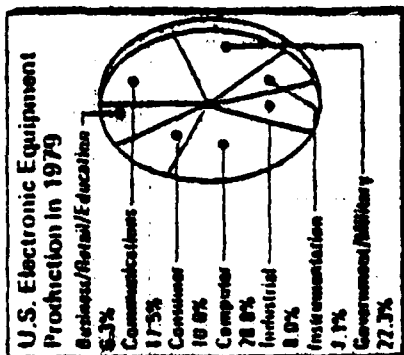


Figure 85 : Analysis of U.S. electronic equipment production



Figures 83 , 84 , and 85 illustrate data provided by contractors showing efforts at using trade and industry data on capacity utilization, leadtime projections, and equipment production forecasts as a basis for determining shortfalls in supply.

As discussed in an earlier chapter, companies utilize a system of plans for various programs, and an overall materials strategic plan is typically broken down by program and by subsets of materials. These subsets include such areas as critical materials subplan (the focus of this chapter), subcontracting subplan, investment subplan, make or buy subplan, and technologies subplan. Program subplans would include, for example, breakdowns of major DOD and commercial programs in production, such as the DC-10, Boeing 767, and cruise missile fabrication to show their forecasted volumes and the impacts on lower tier supply capacities. A specific capacity utilization chapter is given later in this report. The technology subplan is also discussed in a later chapter as is the manufacturing technologies subplan.

Summary and Conclusions

How recent is this type of managerial planning and how thoroughly developed is it? To answer these questions, the following perspectives are provided from interviews with materials managers:

We began linking our IR&D and planning for materials a couple of years ago into our strategic planning cycle. Then we started with more questions than answers. We then became more formalized in our participation of critical materials planning in the strategic planning cycle. We have now come up with a materials strategic plan, although in my estimation a very elementary one. It started with asking questions and is now beginning to get answers, but is still oriented toward broad questions such as "What do you see as key issues in our strategic plan relative to resources?"

In three companies studied, the level of critical materials management had not progressed this far yet. It was generally ignored in management planning and problems were worked on as they came up.

In other companies, materials strategic planning develops embryonically from one or more issues which become recognized as having their roots in resource market management. The following quotation from a company manager shows this situation:

Take the issue of inflation, which is a big problem for us. It is tied to certain suppliers more than others, we have found. Questions come up, "Should we recompute?" In a period of rising prices what is a normal inflation and what should you recompute? We have not got a good answer for that, since we don't know what normal industry inflation is and when we are merely getting is "stuck to us."

We also have addressed the issue of high reliability components versus standardization as an internal technical problem. Now it is becoming more of a procurement problem. We are trying to influence the government toward standardization so we can have a better position in supplier industries.

The issue of offset as a marketing strategy is another area which has become a procurement problem--developing suppliers in customer countries. In this area we have done well, and have formal plans for offset for each potential sale and each sale has an offset plan in detail for procurement personnel to implement.

Cash flow is another strategic problem. We have to determine what strategic issues materials management can work on to help the cash flow. At a materials management meeting we had this as a key issue. Booz-Allen did a study and it showed us that we need annual planning for procurement very badly. This is not your regular procurement planning or even strategic materials planning or vendor selection planning. Those are still the functional tactical plans. What we found we needed was an in-depth strategic plan of supplier industries and what we were going to do to influence them.

Finally, we recognized we have a lot of key technological dependency outside. It is getting more so. Since we put together a final complex system, we are dependent on all the subsystems and these come from suppliers. We have high costs of launching a program and you have to spread the risk and capital base to finance them, but that creates a lot of technical dependence. We stay flexible to use either of two

suppliers and conduct competitions between them. This reduces our economic risk by competition, but our technical risk concerning if these suppliers will keep us technically competitive with other prime contractors, that is another story. Our system works well with high technology, innovative suppliers, but in the lower tiers it does not work well in technologies in areas like forgings and fasteners. There are technology problems in high strength specialty steels which we face.

Finally, one corporate materials manager provided this perspective concerning his role in strategic planning:

We in materials look at strategic plans for their realism. If a plan calls for cost cutting, we ask how? By design, by value engineering, by what? We then say how possible it is. We send out various material organizations the goals of the strategic plans, before they prepare their operating plans, together with things like Chase Econometrics, data from DRI, and so forth. We give them a chance to see if these reductions are feasible from the supply standpoint.

Several companies have adopted the practice of holding seminars with key suppliers to focus on strategic plans, provide the data to suppliers, and request their ideas and assistance in determining feasibility and in coming up with ways to implement changes. All managers who indicated they had used these supplier seminars indicated they worked well and would be continued or increased in the future.

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Chapter XIII

STRATEGIC PLANNING FOR RESOURCE MARKET RELATIONSHIPS

One of the basic concepts presented in this report is that of "resource markets." Within this concept the reader has been shown the differences between "supplies" markets and "resource markets," in that buying organization not only buy specific supplies--such as steel, integrated circuits, or tantalum capacitors--but a host of services and non-physical resources necessary in the production of weapons systems. The firm's dependency on suppliers goes well beyond the physical supplies which it may acquire and includes a dependency on the suppliers for innovation, technological investment, manufacturing capabilities, capacity expansion, skilled manpower and a host of related resources.

When a procurement organization considers itself successful and thorough when it merely studies, for example, the materials usage requirement and availability of the material, it will miss the important additional resources on which it is dependent in a more indirect way. Matching industry capacity with planned requirements goes beyond merely examining the buying of, say, steel. It recognizes that steel capacity is an important commodity in planning. It must also recognize that skills in steel metallurgy, innovation in production and other strategies of suppliers is also an important resource which it should plan for and, hopefully, entrepreneurially manage.

Thus the source relationship transcends mere buying and selling of a commodity, but includes a host of service and intangible issues important to the buyer and upon which he is dependent on the resource market.

Resource Market Perspectives

The products bought from industry represent only a small portion of the total resource market dependency of the buyer. Typically, raw and semi-processed materials, manufactured components, parts and

assemblies, technologies, geographic scope of suppliers, investment in new processes, availability of trained manpower, and capabilities to work with lower tier suppliers are among the specific competencies and indirect resources which should be addressed in strategic resource market planning. However, typically if resource market planning occurs, it focuses only on the physical commodities. Some companies include manufacturing capacities, but rarely are the other intangible resources--particularly technologies--perceived as part of the external resource market dependency. The authors found this to be the case within the companies that were studied.

A second notion to that of an "augmented resource market" which includes intangible resources is that of multiple tiers in the dependency relationship. Typically, resource market planning examines the immediate backward tier and does not go beyond that. As was noted in an earlier chapter, a company can buy a titanium forging, but if its strategic planning looks only at titanium foundries and casting capabilities, it misses strategic issues of dependency in lower tiers that supply the basic material. Within the aerospace industry, a multi-tiered supply structure is very common, due to the high degree of specialization involved, and it is not uncommon to find six or seven supply tiers behind a component subcontractor. Strategic plans should examine the tiers beyond the immediate firm-to-firm contact of the prime contractor.

Developing/Managing a Source Base

Having introduced the two notions of multiple item/product/service dependencies and multiple tier supply channels, the report will now examine the concept of resource market relationships.

The acquisition process is not one of a single act of contracting or of buying. It is a process through time. Typically, the perspective which the researchers found was one of program by program, contract by contract. If planning occurred it was on a program or contract basis, and not on a long-term relationship basis. Rarely did plans call for specific long range relationship goals with supply industries and firms, but rather with the term of a specific contract.

In only two cases did the authors find any reference in written plans or within the presentations of materials managers which asked questions such as "What type of relationship and association do we want to have with our resource market industries in five years?"

Within the overall resource markets, the buying organization must select and develop relationships with institutions which make up its source base for a strategic, long-range time horizon. Over the time horizon of the strategic plan, the character and make-up of this source base must meet the strategic objectives, goals, and the strategies of the buying organization. For example, if the buyer plans on long term technological superiority, global expansion, domination of costs in the industry, or whatever, the source base must be strategically capable of supplying resources to support these objectives. This includes a mix of emerging institutions as well as currently available suppliers.

A source base must be balanced in capabilities. In a situational contract-by-contract setting a source base is defined as a multiple source group of suppliers to provide competition. However, in a strategic sense, the complex of sources used over a long time horizon should be balanced in contributions. Perhaps no one firm can provide resource strength in innovation, global expansion, cost reduction or other objectives. However, the source base as a total should provide this to the buyer, with some firms providing strengths where others have weaknesses.

Strategic source base development and management requires a broad, intensive understanding of the long range resource needs of the buyer and of supplying industries. It requires a comparative familiarity with each institution and management, strategic plans and programs, of each potential source. In the ideal, the composite strategic plans of members of the source base match the external supporting dependency of the strategic plans of the buyer organization.

To achieve such compatibility with future resource needs, the buying organization can rely on luck. It can rely on the marketing skills and decisions of the individual supplier institutions to eventually

provide the right balance of resources needed. It can rely on luck that its competitive position vis a vis other buyers will put it in a position to gain the correct association with suppliers to have a competitive edge over competition. All of these approaches will probably fail.

To assure attainment of long-term strategic objectives with source bases, both from a standpoint of the source's being available and capable of providing the desired balance of resources and from the standpoint of the buyer's competitive position and relationship with the sources, requires entrepreneurial, proactive leadership of the resource market and of supplier relationships. This is of particular importance where critical products and technologies are within the resource dependencies under management's efforts.

Concerning long-term supplier and supply relationships strategy, one materials manager provided the following insights:

We have a materials strategy planning staff in our plastics business area. Plastics is one area where we have tremendous dependency for feedstocks. Issues have come up about backward integration as the best long-term strategy. We ran a strategy screen on this and a number of integration opportunities. We rated their attractiveness and reward and risk structures together with a schematic of where the value added occurred in the supply channels. We looked especially at phenol and added the total points for the various options.

Things that are driving growth and things that phenol are being used in were the key issues we examined. It came down to value added versus risk of vertical integration. The further backward you go, you can get more assurance of supply and of quality, but there are higher risks in other areas. We concluded that to have strong long-term relationships with selected suppliers was a preferred way to do for us.

Another area we looked at was manufacturing technologies and what the resource market should provide in this area. We ended up with giving specific suppliers goals to improve manufacturing technologies for long-term assurance of getting our business. We did not contract for this, but indicated that if they expected to stay a viable supplier, they had to make the investments.

Stages of Relationships

There are three stages of institutional relationships in the acquisition process each of which becomes an alternative for managing the complexity of risks that are involved. These stages or alternatives are:

- (1) Strictly off-the-shelf commodity buying, on an order by order, contract by contract basis.
- (2) Contractual dealings over a period of time, which often involves some customer development or factors of exchange in the relationship apart from what is generally available to all parties.
- (3) A relationship of commitment which extends itself toward mutual support and dependency over time. This type of relationship is the most difficult to achieve under the "fish bowl" open-information framework of the DOD acquisition process and where competition for the sake of competition is expected as the best way to spend public money.

Under the stage one relationship, the focus is on situational buying tactics and procedures and the goal is to maximize the benefits at the moment. The focus is on the mechanics of exchange and getting the most for what is provided. Under the second stage, the relationship involves a complex of exchanges in areas such as research and development requirements, funding, assurance of supply and demand, and other issues, but the commitment to these is limited.

Under stage three the buying relationship involves a long-term appraisal of opportunities and problems which transcend individual contracts and the relationship may take on teaming agreements, merger, acquisition of stock interest, or merely long-term formal memoranda of agreement. It is this phase of relationships that the buyer begins to think in terms of proactive strategic resource market management, when the very relationship becomes the critical variable.

This stage of resource market relationship involves the customer-active paradigm discussed earlier in this report. It places the buyer in a driving role for influencing the growth and context of resource markets. Relative disengagement with lower tiers is seen as strategically risky and likely to leave the buyer with inadequate supply of the broad range of critical resources upon which he will be dependent.

Figure 86 illustrates a multidimensional model of the stages of resource market relationships, the application of the paradigm of initiatives, and the kinds of products and services acquired. Traditionally, buyers operating in the manufacturer-active paradigm, with an arms-length association, have found this acceptable for off-the-shelf items. However, even here, when manufacturing capacities, technologies, and geographical scope of operations are considered, this passive, arms-length approach can prove a disaster in the long run. The opposite situation is the customer-active, corporate ownership relationship for custom high-technology systems. This also may have maximum risk, since it is all borne by the buyer. What is needed is a good balance of these two styles.

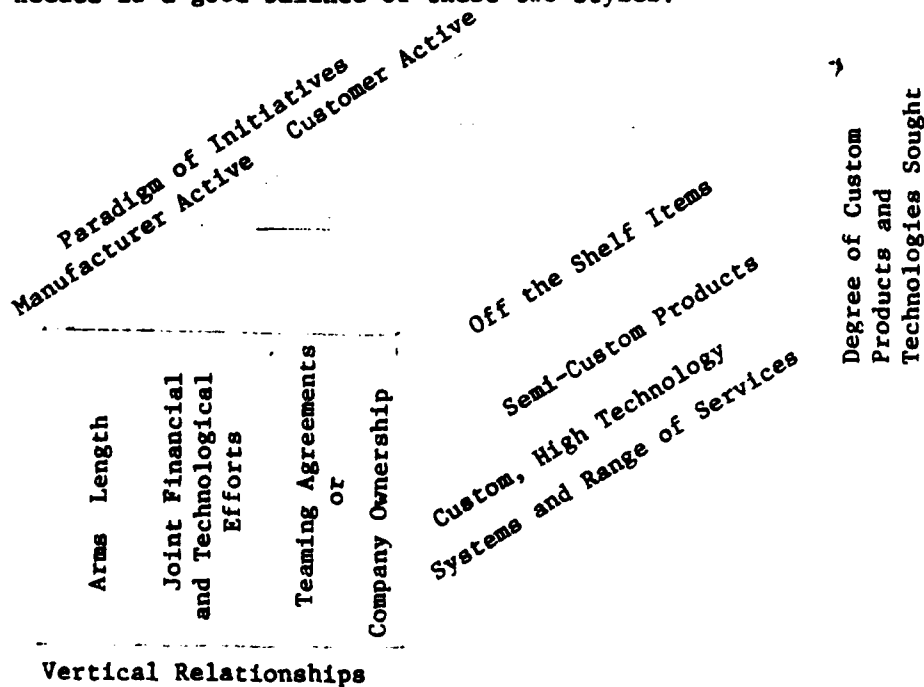


Figure 86 : Multi-dimensional matrix of resource market relationships and acquisition requirements categories.

Relationships and Strategic Planning

Backward integration is only one form of relationships strategy available to provide a solid, assure supply of resources. It also has its risks and problems. Another is to use a proactive, entrepreneurial resource market planning style. A variety of formal methods are available. One would be to develop a strategic resource market relationships subplan. Another would be to have a relationships perspective and flavor to all other subplant--the technology subplan, the critical materials subplan, the manpower resources subplan and others. One of the best examples of the latter was found in what one contractor called its "Subcontract Management Plan."

An important area of strategic resource market management is subcontract manufacture. Effective subcontracting, over a long period of time, requires an integration of all the functional supply capabilities noted earlier: manpower, capacities, geographical growth, technologies and innovation and other. Typically, however, subcontract management occurs by a tactical, operational mode with situational planning the approach used most often.

One company that was studied provided three examples of subcontract management plans. They were addressed to specific vendors, rather than to resource markets, but focused on specific products. In this approach the company assigned specific subcontract managers to do long range planning for particular suppliers and the relationship which the buyer would have over the life of a DOD program. The objectives of these plans were quite narrow and tended to be:

- (1) Assuring that the subcontractor's own program plans adequately defined the activities and schedules needed to fulfill the subcontract agreement, and
- (2) Attending monthly subcontractor coordination meetings and design reviews.

No strategic developmental roles were mentioned or included.

As a corollary to subcontract management planning, another area found in this contractor's planning effort was a document called the "strategic plan for a particular division." This plan, focusing on divisions of the company, dealt with the company/division relationship with lower tier suppliers of forgings and castings in a strategic mode. That is, it was a strategic plan of subcontracting for these capabilities. It looked at issues of providing a viable supply base for these items, market leadership, and competitive capabilities. It specifically defined its market niche in critical parts and defined and listed these parts and how the buyer would stand in the customer market over time.

This resource market plan provided one of the best examples which the authors found of a forward-looking strategic document dealing with a supply industry, its emerging problems, and what actions would have to be taken by the buyer to assure a long-term viable position. It also examined backward, resource market issues in key areas such as critical materials as well as proactive strategies to achieve supply assurance of them. The company would not permit duplication of these strategies in this report, however. One area which is quoted in order to give the reader a flavor of the document is:

Support (a particular supplier) in assuring a solid, cost-competitive, high quality supply in peak demand periods in the future, and assuring that outside forging and casting suppliers remain competitive in price, delivery and quality.

The report then went on to address strategies to assure this objective. It was apparent from reading the document that considerable strategic dialogue had occurred with the suppliers.

Another company provided the authors with a "Materials Strategic Business Plan" which had the following objectives:

- (1) Expand the programs of alternative source development and cost analysis, make or buy decisions, and use of long term purchase agreements to offset 60 percent of the impact of inflation on material costs.

- (2) Evolve the material organization from a centralized group to a hybrid, a diversified organization in accordance with group strategies.
- (3) Develop new practices and methods in receiving, warehousing, distribution, and shipping to help offset inflation.
- (4) Employ automation techniques in materials operations.
- (5) Identify, recruit and develop high potential individuals providing a 1.5 person backup for all divisional materials management requirements over the next five years.

Although not addressing broad issues, this approach focused largely on resource market issues of inflation and manpower to handle resource market problems. However, it set specific objectives and programs to achieve the goals.

Finally, in subcontracting a proactive strategy which has emerged in several companies, largely as a result of the demands of customers, is subcontract offsets. A subcontract offset plan was provided to the researchers by three of the companies studied.

A growing portion of foreign military sales, such plans have become more and more common in the past five years. This consists of granting buying countries a percentage of production in exchange for sales. These are known as direct offsets. They involve the development of cottage industries and suppliers in the customer countries. A notable example of this which has received much publicity is the General Dynamics offset program for the F-16.

Offsets are necessary because many of the countries wishing to buy the F-16 lack sufficient foreign exchange or reserves to pay for the aircraft. Offsets also stimulate the countries' economies by creating jobs, infusing technology, creating a new industrial capability which is leveraged in other areas, expanding existing industry, creating new markets for industry through exports, and providing some internal self supportability. Competitive international aircraft sales have been

particularly good examples of offset production. Direct offsets involve worldwide coproduction as well as development of independent suppliers in customer countries. Indirect offsets are also being used. Direct offsets have the effect of increasing the aircraft cost and, therefore, have an adverse impact on future sales and leveraging. Third world countries are less developed and are often laggard markets. The facilities investment required to establish a direct offset is often too expensive.

Indirect offsets found in some strategic plans are those which do not relate to the weapons system per se. They are usually worked out on a country by country basis and involve industries which are more compatible with the buying country. In many instances indirect offsets can be easily tailored to the buying country. Here are some examples of indirect offsets being managed by procurement personnel in DOD contractor organizations:

- (1) Developing markets abroad for cottage and emerging industries in the target customer country. This might include getting the country export contracts for shoes or tomatoes.
- (2) Developing industries with a closer feasibility profile for the customer country than the high technology aerospace business in order to allow the country to develop foreign exchange and expand its economic base.

Indirect offsets are inherently more effective and generally provide greater flexibility and potential. They do not require direct government facilitization investments and high degree of quality control and production risk. Exports to U.S. customer and other industrial markets are critical in alleviating third world country deficit trade problems and are key targets for proactive strategic efforts.

Often both direct, and sometimes indirect, offsets are contained in the strategic manufacturing plan of the DOD contractor. They are developed as part of the satellite production plans of the contractor and they may actually be used for production of components which the contractor sells to other countries.

Summary

This chapter has examined both a perspective and a procedural approach to strategic management of resource markets: namely, the view of resource markets in a relationships perspective including proactive initiatives from the customer. It has also included the importance of viewing resource market relationships in a multi-tier perspective, including the need for analysis of backward, vertical integration in resource plans. Finally, it concluded with subcontract management plans and the use of direct and indirect offsets as an entrepreneurial tool aimed at not only expanding export sales but also at strengthening the resource support base.

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Chapter XIV

STRATEGIC MANAGEMENT OF TECHNOLOGICAL RESOURCES

This report has labored to stress that resource market planning and strategic issues concern not only material resources, but also technological resources. In the high technology environment of the aerospace industries, when coupled with the rising costs of technology development, many prime contractors become critically dependent upon suppliers and lower tier organizations for important materials and process/manufacturing technologies. This chapter addresses the issues and approaches used in strategic management of technological dependency upon resource markets.

Organizational Roles and Planning Responsibilities

By and large the engineering and advanced development departments perform the technological planning function in companies. However, this planning, when it is done by these organizations, usually includes only internal technologies; that is, those being developed and applied within the contractor organization. Rarely did the researchers find that these departments included external technologies or those acquired directly and indirectly from the resource market and supplier relationships. When external technologies are considered, it is by an informal process of engineering contact with suppliers with no detailed management planning.

Consistent with the responsibilities for technological planning, the engineering and technology functions in the company interface with suppliers and most of the actual technical interchange and consultation occurs in an informal person to person basis. The materials management function rarely has any role in this process, and when a role does occur it is one of trying to keep the engineers from making commitments with suppliers which later will be billed to his organization. In fact, restraining individuals from making informal commitments which later become charged to the buyer is a key problem in supplier relationships.

Typically, the role of the materials management function with respect to engineering and technological interfaces with suppliers is:

- (1) Try to assure that commitments and obligations are not made without procurement review and approval
- (2) Advise and guide engineers regarding the limits of their role in creating expectations and obligations to suppliers through informal agreements
- (3) Perform the technical function of writing and negotiating teaming agreements when a formal supplier technological exchange is to occur.

An important concept necessary for understanding the management process for technological interface with suppliers and the management of technological planning is that of the technological planning unit. A technological planning unit is a formally established organization, either a committee or an ad hoc group representing departments with technological interests. Typical representation within this unit are personnel from engineering, important key program offices, advanced development, marketing, manufacturing, and materials management. It is the task of this unit to perform the internal/external technological assessment and planning function and to guide the organization in its quest for technological development.

All of the organizations studied by the researchers had some form of technological planning. However, technologies in the resource market were often ignored within the formal technological planning and management process. Managers often assume technologies will develop and be available within resource markets. Several indicated that the driving forces of suppliers were such that they were coming to the customer frequently with technology ideas and that there was no need to guide and direct supplier technology efforts. Again, this takes the position of being a passive recipient of what is offered and assumes that this will be adequate for what is needed. The strategic welfare of the customer is entirely in the hands of judgments being made by suppliers in following or not following particular technologies as well as the level of effort involved.

However, in the long run, particularly in areas such as capacities and facilities planning where manufacturing technologies are involved, the possibility of modifying, changing or extending the technology base of suppliers can be a critical part of improving the customer's ultimate product reliability, quality, performance, and delivery capabilities. Procurement strategists who become involved not only in evaluating technological alternatives among suppliers, but also motivating and directing those efforts, can perform a valuable service to their companies. This is particularly true when one views the prime contractor organization as a vertical system competitor. That is, the prime contractor competes for DOD business against other prime contractors as a vertical system of lower tier technological relationships, not merely as a self-contained organization.

Another problem which inhibits technological planning and management both internally and externally is the perception that technology planning is an effort of technologists and engineers, not of managers. However, technological decisions can and should be made by managers with whom overall strategic responsibility is vested, subject to advise and technical decisions being made by the technologists. Failure in this regard results from failure to perceive the technological impact on management success of haphazard and technically-focused planning without the benefit of management direction.

Perhaps one of the reasons why technological planning and management is ignored by materials managers is the fact that technologies are often evaluated and explained from the standpoint of engineering characteristics, not performance and benefit characteristics to the customer in his quest for DOD business. If the vital competitive role of lower tier technologies was better understood from a competitive-edge perspective--whether that be operating performance, cost containment, productivity, or whatever--perhaps there would be a more serious role for managerial planning.

Managerial technological planning and evaluation is a multifaceted field, not just a technical field, and involves evaluation of material, capital investment, information needs, as well as weapons system performance impacts. Process and manufacturing technologies of suppliers can have an

important impact on overall weapons system quality. Product performance capabilities can be constrained by process technologies which were used in manufacturing components. For example, with automobile transmission parts made from certain materials necessitated car makers to limit their warranties until they could develop supplier capabilities to manufacture these parts from other materials using different manufacturing processes. Once these processes were developed, it allowed car makers to extend transmission warranties and, thus, their competitive edge.

In evaluating the technology aspects of suppliers, materials managers need to examine the following five areas of concern:

- (1) The inputs which the supplier needs from the customer for important technological decisions
- (2) The capacity of a technology output for a given investment
- (3) The performance impact of a technology on the end product
- (4) The flexibility of the technology to respond to changing weapons system and mission element needs
- (5) The environmental effects of a technology

Each of these areas should become strategic issues in the technological planning effort. This should include periodic evaluation of existing supplier technologies as well as a long-range look at planned and emerging supplier technologies. With respect to the technologies in the resource market, some companies studied have an explicit function of identifying and classifying emerging technologies within suppliers for study of their impact on the customer organization. One technology planning manager that was interviewed commented:

The strategic plan identifies strategic technologies both internal and external to our organization. Then an ad hoc plan looks at how each technology is to be developed in the future, the funding needed, the likely directions and capabilities that will result, and a time frame. For example, in liquid crystals we have a strong proprietary interest and position and are critically interested in that technology. The

decision was made to move into that line on our own rather than merely to let suppliers work on it. It was too critical to us. We see where they are needed in future military programs (liquid crystals) and are using company funds to work on them. We might need to fund a supplier later to develop a manufacturing process to supply them to us, but we are driving the technology in-house. We must be sure a supplier base will be there, however, to produce them for us, since I doubt if we would actually make them in-house.

Another company had the following comment on lower tier and supplier technology tracking and management efforts:

We often do situational analyses to get strategies to cope with problems, such as cost containment or how to drive prices down. There are potential competitive pressures within the solar energy industry for silicon. If energy costs go up high enough, we are in trouble. You can make circuits for one million ICs from the silicon used for one solar cell. So we have to watch the impact of solar cell technology and what it will do to the availability of silicon wafers for ICs. We are tracking solar energy technology even though it has no direct impact on us.

We try to track several lower tier suppliers' technologies with both direct and indirect impact and even suggest to vendors ways that they might go. We must be careful because too much suggesting may lead to a commitment on our part. We have periodic technology reviews with vendors, and our technology group spends time with specific vendor industries, such as semiconductors, telling them where we will be in several years and what they need to do to keep in line with our needs.

However, we have found that we need a policy to protect us in working with long-range vendor technology plans. On something that is vendor confidential, we require that they sign a non-disclosure statement which binds them not to tell us about the technology. We are in competition with many of them and cannot take a chance that we will be criticized for stealing their ideas. They can tell us about mechanical items, but not the family jewels.

Technology Access and Transfer

An important part of management of technologies in an intercompany, dependency environment is the issue of technology access and transfer. Companies dependent upon resource markets for

process and product technologies must develop means of access to these technologies as well as vehicles for transferring it to the customer in the relationship process. Technology access starts with technology planning. The first step in the planning process is determination of technological needs, and the second step is environmental assessment to determine technological opportunities.

Identifying technological opportunities within the resource market requires the inclusion of technology issues in the environmental surveillance function in the information subsystem. This search process is guided by an internal appraisal and assessment of technological usage and criticality. The following is a statement provided by a divisional materials manager concerning technology criticality in resource markets:

We feel that it is important to determine the criticality and dependency risks for technologies we obtain from suppliers. In effect, we determine a technological make or buy decision. The major criterion for a "make" is the criticality of the technology to our planned system operation. We have several technological make or buy studies that have been done including an assessment of options for technology access through buy or through internal "make." This is done on an ad hoc basis and usually is funded by the engineering department.

Furthermore, we do criticality studies relative to our future plans in program development based on unsolicited proposals which come in from suppliers. They propose specific technologies which they would like to work on and want funding from us. We assess these for criticality and in some instances we fund them in some joint arrangement.

A good example of the make or buy issue is in LSI and VLSI circuits and we are looking at in-house versus suppliers as the approach right now. Ten years ago we would have definitely gone outside, but now the criticality decision is aiming us more toward an in-house approach.

Another materials manager gave this perspective on the process of determining technological criticality and access methods:

We try to rank technologies into the future in terms of criticality to our competitive position and posture and choose from this ranking the ones we will support from internal budgets. They may be supported in terms of budgets for human resources or for capital investment. We consider technological facilities as a critical item just as much as product technologies. People assets are also important technologies in the overall equation.

We try to rank ourselves versus competitors on the technologies both now and in the future, as far as we can determine where competitors are likely to go. We then prepare a matrix of technological criticality and our competitive position--including, external technological access in the resource markets--using a matrix like this:

		Technological Criticality to Our Future Program Plans		
		High	Moderate	Low
Company Current or Future Competitive Position	Strong	X	Y	
	Moderate	Z		
	Weak			

For technologies where we have a high criticality, we would like to have a competitive posture, including supplier agreements, which are strong--represented by the X. Where we have only a moderate position, such as Z, we will do a study of options to improve our position--such as funding in-house development. A Y position indicates we may have a strong access to a technology, but it is not seen as critical as one where the X is located. These may get a reduction in the budget.

This matrix came out of our strategic planning organization, and I have just begun to use it in assessing our relationships with suppliers. We are not really doing a good job of that yet, in my opinion.

The criticality assessment must coincide with what is in our strategic plans including the timing of when the access will be available and when the need becomes critical. In some instances suppliers are not devoting enough effort to a technology to have it on-stream when we will need it. In these cases we examine possible funding programs with them.

An important part of technology assessment and management is technology base planning. This means that the customer organization must examine an overall technology base for all aspects of a planned weapons system and then judge from all the technologies needed, which ones should come from a supplier base and which from an internal base. The technology base represents a composite of internal and external sourcing decisions or a make or buy complex. The kickoff point for many companies in this step comes from the new business development funding effort. The following perspective came from one company management:

In this regard we have new business orientation reviews which examine technology funding. These reviews occur twice each year and we publish the results in our overall long-range technology plan. This is a functional plan prepared by engineering. It identifies the critical technologies which will drive our business for 10 to 15 years, and, in turn, it is tied to our Bid and Proposal (B&P) and Independent Research and Development (IR&D) funding.

These technology plans include technological forecasting as well as technology base development plans among our key suppliers. We have a section addressing supplier technologies and where they are going and what their capabilities will be down the road.

Where it is a critical issue to the company that a supplier technology keep on track, we develop a closer relationship with a supplier in a formal approach which we call a National Account Agreement. This is an agreement between the two companies on support levels and also an agreement not to divulge each other long range technological plans which might cause a legal problem. All we do is be sure we are talking the same language and that we are working in compatible directions. We sometimes commit some of our own funding to a subcontractor to help in his technology development, and this is typically done where technologies facilitate product improvements in performance or for cost reduction.

Teaming Agreements

Among the various vehicles for providing technology access and transfer are:

- (1) Informal access incidental to buying products
- (2) Licensing of technologies from suppliers
- (3) Joint ventures in technology development
- (4) Internal development

One of the most popular methods of technology access and transfer is through a teaming agreement. This section presents findings from interviews concerning the use of teaming agreements by DOD contractors with lower tier suppliers.

Many of the weapons systems developed for DOD involve the acquisition of high technology subsystems from lower tier specialized suppliers. Prime contractors search for specialized suppliers prior to solicitation from DOD and develop proposals which are based on teaming with one or more suppliers. Teaming means that the contractors work together under a formal relationship with each supplying an area of product expertise. Such teaming agreements are often exclusive in that no other parties are involved. That is, a lower tier supplier works exclusively with one prime contractor and the ability of the lower tier supplier to be successful in eventually providing a subsystem for a

weapons system is dependent upon the prime contractor winning the DOD contract. Should the prime contractor be unsuccessful, the lower tier teaming partner also loses. Some teaming agreements become non-exclusive after the prime contractor loses, in that a lower tier supplier is then free to compete as a second source with another prime contractor's teaming partner. However, where long life cycles of compatible technology development are involved, often by the time a prime contract is awarded it is too late for a lower tier supplier to switch partners.

A teaming agreement is a special case of risk sharing in high technology manufacturing. It involves several years of working closely in developing compatible components and technologies, or it may involve a teaming for a new material to be used by the prime contractor. Under such an arrangement funding support often comes from a prime contractor, but in many circumstances the lower tier supplier shoulders the termination liability himself with a payoff coming only if and when the prime contractor is successful with DOD. What is the role of procurement management for such agreements? One materials manager had the following comments:

We are part of a team to convince a supplier of the market potential of a DOD award and of our likelihood of success as the prime contractor. The credibility of this is determined by our ability to forecast which systems will be successful in getting funding and which we will be successful in winning. We go out with engineering personnel to try to develop and interest sources in teaming with us. This is well in advance of any actual announcement from DOD. By the time a solicitation comes we usually have invested some of our own money and a lot of teaming partner money in technology teaming. We seldom use any IR&D money for teaming.

Teaming agreements involve considerable down-side risk for both partners. As one contractor management put it, "If a company waits for an announcement of a contract solicitation from DOD, you will be too late. You have to go ahead and risk the program being cancelled or you will not have time to develop the capabilities necessary to compete technologically."

Another subcontractor management expert had the following comments:

Our proposal team is bigger than our division, and it includes several teaming subcontractors. This is those who will assist in building the system. We require up front investment on the part of these companies, and often a subcontractor develops a process at his own expense with no guarantee from us that we will use the process he is developing even if we get a contract. We may then for samples of prototypes built for us, but when they invest in a technology they do this at their own risk, since we are often not sure until later in the program which technologies will work best.

If we and our suppliers stay at home where it is nice and safe until we have a contract in hand we will get old and bankrupt. We have to make judgments on where will invest dollars to capture a program and execute the technologies for that plan.

However, we make many more attempts than we get successes in getting people to invest their money in areas we want. Generally, if there is a market, we attempt to get a supplier to spend money to go for it. If we do not have success, we have a couple of choices. One is to keep looking for sources, and the other is to do it yourself.

As time goes on, we are getting into more longer term development relationships with suppliers, although there was a period when we did little of that. Now we are moving in that direction. We are beginning to write a developmental description of subsystems and use those in a procurement plan to attract teaming partners. A mini-specification is written and we solicit interest from prospective suppliers. Often they come in here asking to work with us.

The planning cycle for technology development programs, including teaming agreements, is explained by the following comment:

Say, for instance, we define a military need for landing marines on a beach and for direction finders. The

engineers consider the capabilities we have in-house and those known on the outside. There is a technological make or buy analysis that is done. Procurement interfaces with engineers on this. We try to avoid tying ourselves down to limited options.

One example of teaming for problem solving involved insulation for the inside of a cryogenic tank, and we were trying to provide the insulation effect without increasing the outside diameter of a tank or significantly decreasing the inside diameter. It was an engineering definition of wanting a unique capability. It turned out that we found that there was a product made from foam with open cells in it that let fluid in so it could flow all the way through. Our role was to find or develop a source for the foam. We found a firm that had worked on it, but had shelved the idea for lack of a market. We worked with them and developed them as a source economically, and they are supplying us with the foam now.

If there is manufacturing technology or capital investments needed in teaming, there is usually a precise discussion and planning of risk exposure that must be negotiated. However, usually most or all of the exposure is sheltered by suppliers, according to the managers that were interviewed. As a corollary to the teaming idea, some firms trace the development and evolution of technologies within lower tiers as a means of avoiding teaming. In several instances the authors found future plans involving complex technology evolution plans and leveraging of product lines regarding technologies to make them economically feasible.

Leveraging of risk exposure is aided by the use of a technology map. Figure 87 shows an example of such a map showing the linking of technologies throughout IC development. A similar approach is used by many companies for technologies which involve high investment and must necessitate leveraging.

Product Line Families and Linkage of IC Chip Technologies

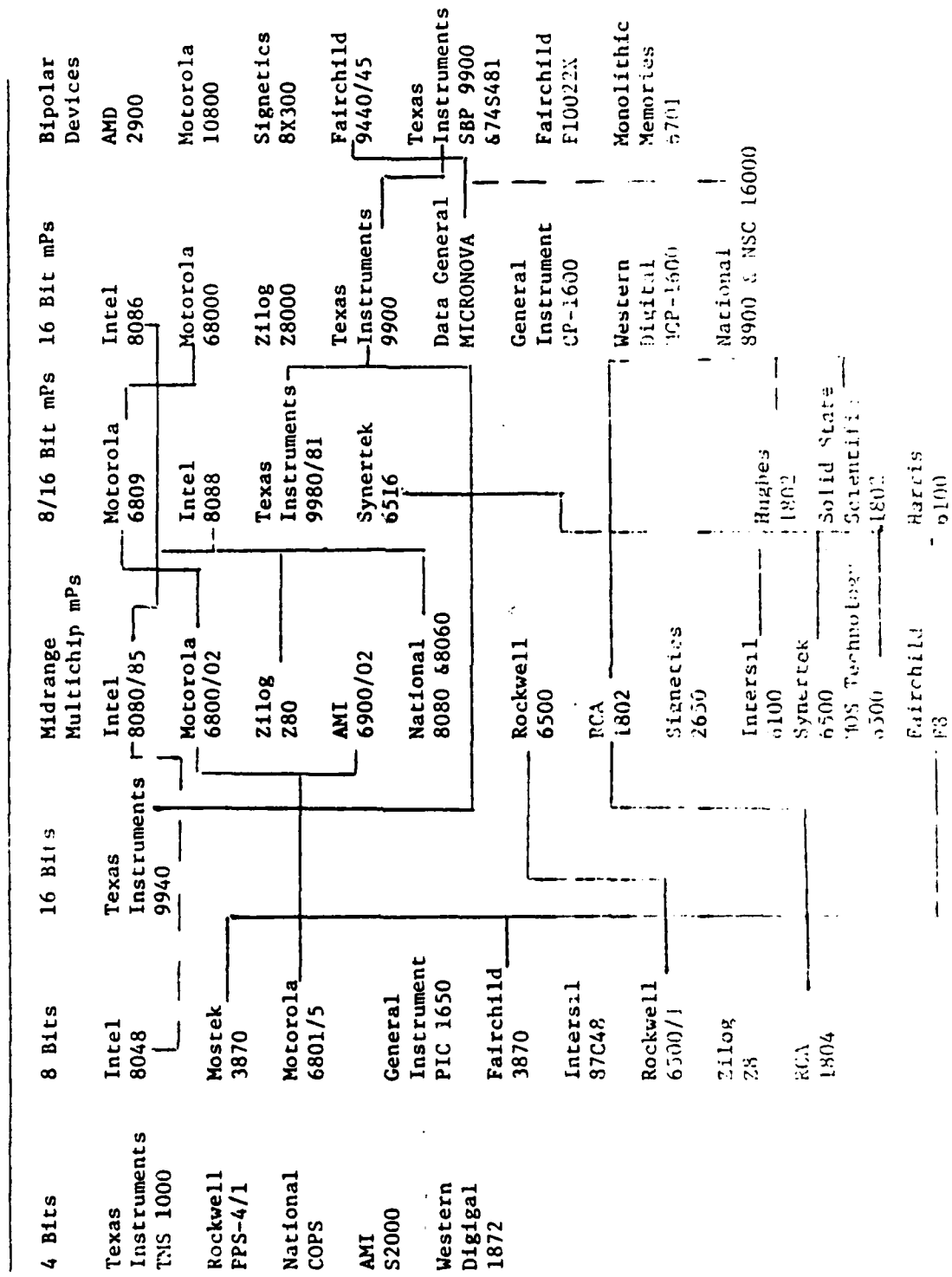


Figure 87: Technology map of IC linkages

The role played by the prime contractor in applying proactive efforts to gain lower tier support for developing technologies differs widely among the companies studied. Some rely almost entirely on a lower tier, manufacturer-active approach, while others spend their own money to get suppliers to develop the needed technologies. The following scenario was provided by a manager in a company with an approach more toward the customer-oriented paradigm:

We have several programs where we share our money with subcontractors to help them develop specific defined technologies. We must have a stack of teaming agreements several inches thick in my office. Both teaming agreements and memorandums of understanding are used. During planning we get involved in teaming agreements because we first have to go back to corporate headquarters and get the chairman of the board involved in teaming. All teaming requires board approval before we can get involved.

Our role is often that of merely giving a subcontractor some downstream visibility of what he can expect from his effort, while in other cases they won't spend their money. Some subcontractors are more sophisticated than others. Some will have a formal opportunity analysis with application of various probabilities for each opportunity balanced with financial returns. We find much more sophistication in the electronics industry than in, say, the airframe industry. In the electronics industry they define their competitive base some five or six years out. The now environment is not their real competitive environment, it is the environment of five years in the future where they are competing.

Consequently, it is the type of industries and the perspective which management takes about the horizon of competition which often determines future orientation in planning of technologies. Where lower tier industries are more aimed at competition in the present, it takes more effort and often customer funding to get efforts aimed at long-range technology development.

DOD Acquisition Policies and Technologies

During the interviews with management, the researchers attempted to get the perspectives of managers concerning several DOD acquisition policies and procedures and how they influence technology planning and risk taking. This section presents some of the results of these interviews, although the data are quite vague on this issue.

Of particular interest is the impact of the A-109 document upon resource market development and the use of long time horizons for alternative technology development to provide DOD with optional solutions to mission needs. This section is devoted to contractor views on A109 and on the use of IRAD and CRAD (contractor financed research and development). Before discussing IRAD and CRAD a clarification of terms is needed. Within DOD the term IRAD has been used to determine governmental monies going to industry--IR&D and B&P. However, within industry, the term IRAD refers to "independent R&D" or monies provided by the company, whereas CRAD refers to the monies provided under the government contract--what the government refers to as IR&D. The different usage of the same terms can prove confusing. In this section we will use the contractor terminology.

The following perspective was provided by a manager at a contractor facility concerning A-109 and technology funding:

Under A-109 we are planning to compete all the way through the acquisition cycle. So we look at planning in a different way now. So far it has aimed at surviving that long. Let me address the impact of A-109 as I see it. It says that we are not buying aircraft, but we are buying a solution in a broad context. That means we are competing technologically with aircraft, missiles, satellites, what have you. A company can no longer just be in the aircraft business in terms of technology understanding. We are not just competing with other aircraft companies, and must understand the capabilities of technologies in other industries. Our environmental focus in surveillance is broadened to include several industries now.

As a result, it requires approaching a mission problem from a broader technological base both internally and with respect to supplier relationships. They have to look at outside technologies in competing industries as well. In the procurement area, this means spawning interactions with a variety of different types of suppliers that can provide that kind of flexibility, and your planning becomes more complicated. Under A-109 you have an infinite excursion through options.

The end result of it all is being far enough ahead of the emerging mission need, yet broad enough to propose a competitive solution that will survive until production. That solution will come from the combined resources of the government, laboratories, and contractors down through lower tiers.

So we have to have gining and get into the technology cycle conceptually much earlier. We have to be selective in our use of resources, though, and can't chase lots of ideas. We have to prioritize which we will use in our competition.

We are in an introspective posture now about it. In some people's minds we are already too broadly based. Maybe we should pull in and redirect our efforts. I recognize the importance of being broad based and we have our CRAD and IRAD feelers in many directions and peripheral areas. But there is an interesting organizational question for a company like ours based on A-109. We are organized by program lines and types of vehicles. Is this organization structure too closed ended to meet the A-109 approach? We tend to propose configurations which meet our organization structure. We define our business in areas like "expendable launch vehicles," or "anti-ballistic missile" programs. However, the approach to the problem must be left open.

Further, you have a conflict in using your monies for short-term payoffs versus long term ones. We need to nurture programs in early phases and look forward to payoffs in five years. It is hard to do this with new business funding when you are chasing so many directions.

Another A-109 issue is spending front-end money to save long range costs. Nobody wants to do that. The reason is that you are in a political arena and the guy who makes a decision to advocate more money this year, probably won't be around in ten years to see the payoff of his choice.

From the above scenarios, it can be seen that although A-109 may be designed to achieve objectives for DOD, it also places increased expense upon contractors to do planning and technology management in a variety of areas. Few companies can afford to do sophisticated technological planning in a variety of areas for an extended period of time. When several companies are doing this, and DOD is requested to reimburse the effort, the costs to a program can become prohibitive. This was the view shared by many strategic planners.

Technology Planning for Semiconductors

Finally, this chapter will conclude with an examination of technology management as it occurs within one specific industry, semiconductors and this section will report the results of materials provided by three companies involving technology planning in this resource market.

The U.S. semiconductor industry has provided the tools of technological change in many other industries and this broad market application has been a critical issues to materials planners. The diversity and scope of impact of market usage of semiconductors makes it a particular challenge in technology planning.

In response to critical issues in semiconductor supply and the need for developing technologies in semiconductors to maintain both a differential product advantage and cost leadership, several companies have been involved in a wave of investments in acquisition of semiconductor producers. Many of these have posed added problems to acquiring organizations.

Thus, the approach to technology planning which has prevailed in this industry has been acquisition, not teaming or licensing. Some predictions place the world semiconductor market at \$20 billion per year. Semiconductors now average nearly five percent of the value of all electronic equipment versus less than one percent a decade ago. What will be the result?

Access to new semiconductor technology has become a key issue in strategic planning to several companies in commercial and defense production. For example, Digital Equipment Corporation, a leading minicomputer manufacturer, and a heavy user of semiconductors, has faced this problem as a key strategic issue: assurance of access to leading-edge technologies. The prediction is that virtually every major manufacturer will soon become dependent on semiconductor technology. The result will be an extension of numerous offers for investment in smaller semiconductor producers. Out of thirty-six semiconductor start-ups since 1966, only seven survive now. Increasing vertical integration in relationships has occurred. This vertical alignment reduces the chances of technical leveling across the industry as end users become more dependent on a single source of supply.

Those companies unable or unwilling to acquire companies have put large amounts of capital into in-house capabilities. The enormous volume of integrated circuits being purchased by a few large customers is radically changing the relationship of semiconductor users with suppliers. It has been estimated that the number of companies using more than \$100 million in semiconductors has jumped seven fold in the past three years. Figure 89 shows the vertical integration in the industry that has occurred as a result.

Not only does the trend to vertical integration pose a serious resource planning issue, it may also impact on the creativity and innovation in production among captive producers. The entrepreneurial spirit which established the semiconductor industry may become reduced by this trend. The alliance between users and producers for more focused applications may restrict technology development from the level gained when independent relationships occurred.

Finally, with respect to DOD, the proportion of DOD purchases from the semiconductor industry is declining. Figure shows the trend. This means that less and less monies will be spend toward developing needs aimed at DOD relative to those aimed at other end markets among the non-aligned producers.

Corporate Acquisitions of Semiconductor Producers

<u>Year</u>	<u>Supplier</u>	<u>Buyer</u>	<u>Estimated Investment</u>
1975	Signetics	U.S. Phillips Trust (Netherlands)	\$49 million
1976	MOS Technology	Commodore International	1 million
1977	Litronix	Siemens (West Germany)	16 million
	Adv. Micro Devices (20 percent share)	Siemens	27 million
	Solid State Scientific	VDO (West Germany)	5 million
	Intersil (24 percent share)	Northern Telecom (Canada)	11 million
1978	Electronic Arrays	Nippon Electric (Japan)	9 million
	Spectronics	Honeywell	3 million
	Synertek	Honeywell	24 million
	American Micro- systems (24 perc.)	Bosch (West Germany)	14 million
1979	Mostek	United Technologies	349 million
	Microwave Semiconductor	Siemens	25 million
	Fairchild Camera	Schlumberger (France)	397 million
	Unitrode (14 perc.)	Schlumberger	10 million

Source: Dataquest, Inc.

Figure 88: Corporate acquisitions of semiconductor producers

Changes in Horizontal Market Penetration of Semiconductors

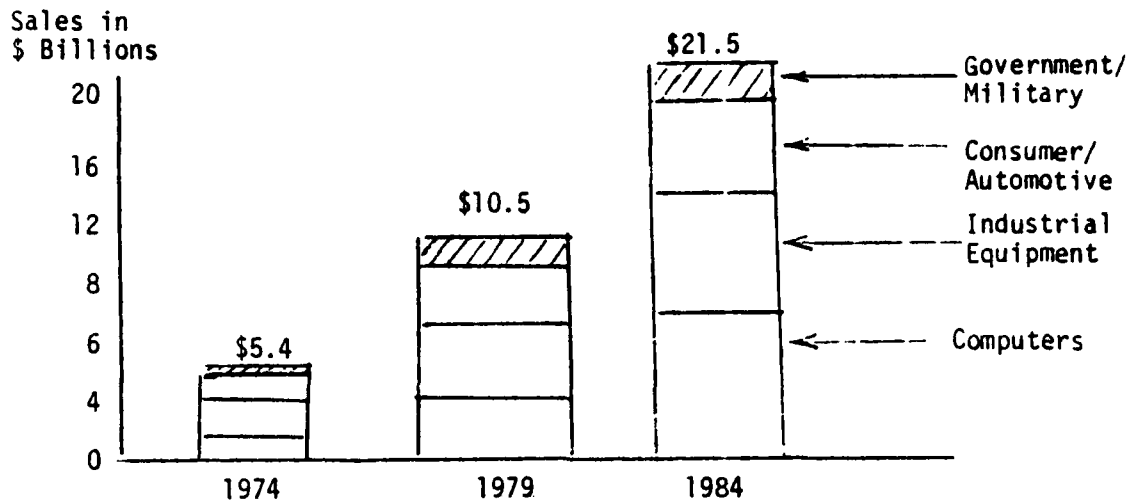


Figure 89 : End use markets for semiconductor production 1974-1984

Projections of end use market segments through 1990 show that computers will grow the strongest, up some \$12 billion, while automotive is to grow by \$9 billion by 1990. The average growth rate for semiconductors from 1970 to 1990 is expected to be seven-fold. Military uses are expected to increase only three-fold.

There have been many changes in the close relationships between suppliers and users. The latest semiconductor chips on the market can provide far greater capabilities than most users really need and there is a problem in finding outside applications for captive production. The diversified end uses and the requirement for sky-rocketing volumes to keep costs down has led to a reversal in some companies toward more out-side sales.

The problem which has been developed in resource market plans for semiconductors goes beyond technology development and availability. The scramble for semiconductor expertise is coming from many directions. Xerox built a 2500 employee electronics operation, and the half-dozen chips already developed by the company have become key operating components in seven of its copier lines. Will inability of aerospace companies to balance risks necessary

have this kind of success in semiconductor technology cause a serious lag in operational capabilities in military systems? Is there a mandate for more commercial component standardization? Will the sale of high-technology computer systems to the USSR provide them with technology transfer which has impacts for military systems? If so, will this allow them to gain a performance lead in semiconductor applications?

The semiconductor industry is also plagued by a problem typical in many high technology industries. It is the need to keep abreast of state-of-the-art. This can cause financial difficulties if the end market is not broadly based. Captive producers have this problem in particular. One company, for example, may have a planar magnetron sputtering machine, because a competitor has one, but not be able to amortize the cost. The return on investment analysis is often developed after the investment is made for competitive reasons.

With DOD's lagging policies toward paying for return on investment, this may become a particularly acute problem in companies which are major DOD suppliers--justifying state-of-the-art expenses. At the other end of the spectrum, some companies complain that too much financial management has occurred and has been a constraint to technology momentum.

Finally, another resource market issue for semiconductors which was discussed in contractor strategic plans was the international technology transfer and offset situation. Europe is rapidly developing its own "silicon valleys." The European Economic Commission has drawn up spending programs to encourage fast development and production of equipment to support semiconductor development. Much of this, as the previous figure showed, comes about through acquisition of U.S. companies. Japan is also a major world resource. Nippon Electric's 1979 sales of 16K random access memories was in excess of 11 million. Japan has been judged to have the lead in state-of-the-art memory chips. Will this mean more foreign sourcing dependence for DOD systems?

Strategic analysis of the semiconductor industry also shows several significant financial problems. A key one is the capitalization to sales ratio necessary to enter the market. The industry typically has a ratio of about 1 to 1. It takes a dollar of investment to gain a dollar of sales, while most venture capitalists see a ratio of about 5 to 1 required for investments with today's money markets.

Summary and Conclusions

This chapter has presented a discussion of conceptual and procedural issues relative to strategic management of the acquisition of technological resources, some of the approaches to proactive technology management from external sources being employed by DOD contractors, and an example of a study of a technology resource market and the emerging strategic issues of interest to DOD contractors.

References

References used include those previously noted in the chapter on high technology organizations, Volume I.

Chapter XV

STRATEGIC MANAGEMENT OF EXTERNAL MANUFACTURING RESOURCES

The purpose of this chapter is to examine the role being played by DOD contractors with respect to managing the external manufacturing resources upon which they are dependent. The focus is on manufacturing capabilities and capacities, rather than upon access to materials and technologies. This section reports both the perspectives and the programs which are in place among several companies.

Philosophies and Perspectives

Although some managers who were interviewed focused on taking proactive efforts toward external manufacturing resources, most were either fatalistic concerning the issues involved or felt that someone else--such as DOD personnel-- should take the action to correct deteriorating and insufficient manufacturing resources within the lower tiers of the defense industrial base.

Nearly all materials managers interviewed felt that manufacturing resources, particularly in specific industries, were a critical and strategic problem. Most expressed evidence of the problem through greatly extended lead times, but several also indicated the demise in availability of military specification components and explicit decisions among suppliers to discontinue manufacturing of low volume, high specification military items in particular.

The following quotations came from managers with the relative perspective of "there is little if anything that we can do about the problem:"

On capacities in large presses, we have inadequate supply capacity in the industry to handle our peak periods of production in both commercial and military needs. We will face this backlog for the next several years. We try to get government to stockpile, but large press time is difficult to stockpile. It is a service commodity, not a physical commodity and you can't just buy up a bunch of it and put it in a warehouse. The forty-two months to queue up which we are facing does no good for the national defense.

Most of the problem comes from the suppliers unwilling to expand capacity investments to be able to meet production in peak times like now. Furthermore, they see the future military demand as shakey, and they do not want to invest to support such a shakey effort, especially at the cost of money that we are facing.

The tremendous growth in commercial and defense demand together causes a problem in the aluminum and steel forgings industries in particular. Press operators have seen that they peak up, lead times go out, and they are running at maximum capacity. Then the demand drops off suddenly and they are down. They have decided to stop making huge investments for the blips in demand which may last only a few months.

Their strategy is to let the supply and demand cycle operate and make money all the time. The customer just has to wait longer. Now we see that prices of forgings and aluminum products have a significant rise due to that strategy--pricing what the market will bear in times of surplus demand. We have had a substantial increase in price due to demand pressure from the Japanese. They are buying energy from us in the form of aluminum. Why pay for the energy themselves when they can use ours by buying aluminum?

There are a lot of industry collective actions going on. The whole industry quotes you prices at time of delivery. When this coupled with long lead times, you have no idea of determining what your price will be. The forging industry has the policy you pay for the dies, but they own them and you can't move them to another company who may have open capacity. If you say to them you need a forging in twelve months, even if you bought their dies, they say no. If you say you will go to another company and you want the dies, they say no. This is an industry practice of no transfer of dies.

Our industry needs to have a more in-depth review of the pipelines of basic materials and what should be going on in stockpiling. Titanium is an example, and we had it approved for stockpile, but had no item in the budget. We also had no item in the budget when silver hit \$50 per ounce, and had no ability to dump it to buy titanium. Now silver is down and titanium is up. The budget procedure won't give you the flexibility to play commodity markets.

The whole problem in the lower tiers comes from their perception of DOD. If they perceive a program will be around for a long time they will make capital investment and get facilities. When they see a program is politically volatile, they won't risk it.

This perspective was contrasted by a director of materials who saw his job as more one of "marketing in reverse:"

We in procurement go out with a marketing presentation to our key suppliers, including materials producers and subcontractors. Who are key ones--those that will cause us problems of any strategic type. We show them what we perceive to be the market --local and export-- and try to get them enthusiastic enough to continue to work on getting costs down and making the necessary facilities investments.

We have better luck on commercial projects than on military ones. An area of particular concern is in making investments to improve productivity and profits. It is philosophically incredible in our society to make a profit off a war. Defense is war, and psychologically we are bent that results in profits should be avoided. We have to work against that in our campaigning.

Ironically, more and more of the defense dollars the country spends are managed directly by procurement managers in prime contractor plants such as this one. This will continue to increase so that directors of procurement will actually be spending a majority of the money the government allocates for defense! They give it to us and we spend it! But we have our hands tied by government on the rules of profit and allowances. Everything you see on an airplane is bought. The fuselage comes in big sheets of aluminum and we merely shape it and cut holes in it. We buy drills to do that, guns, tools, even the plant. The airplane merely changes shape here. It is bought by us from the lower tiers. We in procurement are right in the front of the waterfall, and no water goes over until we crank up and feed the factory.

However, most people in the company, including the president, don't know what procurement does. But nobody can enlighten them like the procurement manager and that is my job. Selling the procurement function internally--that is my job. But we have our own biases. If you are a VP of operations, you have grown up with a traditional view of procurement. So we have to buck our own bosses on roadshows about what procurement is becoming.

Marketing and procurement have roles that are very similar. Ours is to represent all elements of the corporation to the resource market --the suppliers. Marketing's is to represent all elements of the corporation to the sales market--the customers.

We go right into the supplier's marketing and engineering operations and talk to them about specifications, about us, about our product, about our customers. If not, we are not doing our job. We must work with all elements in the supplier organization, quality, finance, marketing, you name it.

This procurement director went on to say that in his travels and efforts within the National Association of Purchasing Management (NAPM) and others he has seen that procurement managers have generally failed to see their role that way. They are traditional materials suppliers and they are hurting their companies, DOD and others by this "archaic perspective." Typically these managers merely buy to support manufacturing, and their bosses and others see them in that role and merely reward them for that. The manager went on to say:

They say 'What is this costing us?' But they don't realize that manufacturing is a smaller cost of the product than procurement is. We have 7000 suppliers in ten countries, but they never get seen by others in the company. We are concerned about our manufacturing costs, but not theirs--even though theirs is a larger relative amount! You actually see the manufacturing operation in your plant, so you concentrate on that as a key issue. The percent of impact of procurement is much greater, but the impact on top management is very low. Unless the top management is shown to understand it and that is where my roadshows come in.

Most procurement people are grossly underutilized in their organizations. If management would create the idea in the company that the function is important

to the outside world and if they would make the world believe it, that the decision to buy something rests on the procurement group, the behavior of suppliers would be much different when the company needs help. When purchasing called for it, we would get it. But the authority is so diffused, that the suppliers don't know who to count on.

All too often, when making an award for a new program, those in charge come from marketing or finance. They want to call the president of a supplier and tell him of the award, and they don't go through materials. They leave us out, and what does the president of the supplier say? Procurement has no clout!

This does the company a tremendous disservice by creating the illusion that there are those who pass out the business in positions other than materials. We get upstaged by those who don't really know what they are doing in managing resource markets.

This happens in government too. When you see a Space Shuttle or an F-16 award, and it gets press coverage, who gets the credit? NASA? Air Force? No, a Congressman. In fact, even NASA or the the Air Force should not get credit when the mission works well. It was Rockwell or General Dynamics that built it and they should get the credit, but they don't even get their name on it! You bet they will get a name out though if something doesn't work correctly.

Most government contracts are announced by Congressmen courting votes and this gives an illusion. It causes the constituency to act in a detrimental way--the Pentagon is the bad guy--the waster. The guy making the award--the hero--is the Congressman. DOD agencies should announce the awards, not Congressmen. They are the acquisition managers. But they are not elected, so they don't get the credit.

I know I am going on, perhaps too much on this, but the materials people have to sell to those they work with and for what they do strategically and gain the respect of those with whom they interface in the company. When a new product or project comes out, the man who will head it has no exposure to procurement. We must tell him we have a part in the organization and force ourselves in the door.

I work with 7000 companies in five areas of key problems for us--scheduling, pricing, contracts, specifications, labor and have some 35,000 problems every day (7000 times five). If one percent actually become problems, that is 350 problems each day to work on. When they see this is how procurement operates, they see you accomplishing something.

Manufacturing Resources Planning/Strategies

Manufacturing resource management should not be viewed just as an area of necessary problem solving. It can be a major competitive opportunity for the buyer to develop external manufacturing resources which provide for cost reduction, quality/productivity improvement, or other competitive advantages. Thus, the perspective of strategic management of manufacturing resources runs all the way from the apathetic materials manager who merely reacts to extended lead times for materials, to one who tries to prevent lead times from extending to one at the other end of the spectrum who develops proactive efforts to improve his company's competitive position in its relationships with manufacturing resource suppliers.

In the remainder of this chapter, manufacturing resource management will examine two issues: capacity resources and manufacturing technologies. Capacity resources refers to the physical industry capacity and bookings of capacity--the lead times problem and the inherent impact of demand over supply on prices. Manufacturing technology resources refers to the investment in new technologies to improve manufacturing capabilities--either improve productivity and efficiency or develop new manufacturing capabilities or the ability to process new materials into the needs of the customer.

The questions which are discussed are, consequently, twofold:

- (1) What, if any, role do DOD contractors' materials managers play in supplier capacity investments and strategic plans for expansion?

- (2) What, if any, role do DOD contractors' materials managers play in getting suppliers to invest in improved manufacturing technologies?

Production Readiness Reviews

Most of the contractors studied do not conduct formal production readiness reviews for suppliers. Although such reviews are held internally--largely required by DOD--they seldom go into lower tiers. The companies themselves do little to forecast industry capacities and available time beyond a few months. Most likely when capacity constraints are known they have become known in response to a request for manufacturing and the supplier quoting an extended leadtime. Little, if any, capacity forecasting and shortfall projections occurs relative to lower tier suppliers.

The following quotation illustrates the status of such lower tier production readiness analysis among the companies that are making some effort at this task:

Not only have we gone through an internal production readiness review, but we have also done a disciplined review of subcontractors (Typically for subcontract manufacture, not for suppliers of materials). We did this last year and have tried to look ahead. Our goal is to have some familiarity with industry production readings through the year 1990--that is a match of our forecasted demand and expected supply.

We developed a team to look at this problem and have color codes awarded for each factor that is examined for each supplier on production readiness. If they get a red on a factor, they are asked to do something about it, whereas a yellow is merely a caution about a potential readiness problem.

Generally speaking, such readiness reviews are very elementary and in only the early stages of management recognition, with even less in managerial development.

Vendor Base Capacity Planning

Closely aligned with production readiness reviews are vendor base capacity plans. Whereas production readiness reviews should examine far out years or production scenarios of varying levels of demand --such as surge capacity --vendor base capacity planning merely tries to identify key vendors, planned vendor usage by major competitive users of the vendor, and what the impact will be on available capacity over a one-two year time horizon. Often such capacity plans do not have a time dimension, but merely look at what vendors are being used by competitors for what production operations.

The authors asked several materials managers and strategic planners if vendor base capacity planning was occurring and, if so, what the results had been. Only one company was able to provide information concerning specific vendor base analysis. In this case, the company had broken down a competitor's planned products, part by part, assembly by assembly, and had determined the vendors being used and the quantities being sourced to these vendors--many of which were the same vendors which the company doing the analysis planned to use for its own new product development and production. Because of the difficulty in disguising the information, the authors received permission to share limited information about this program from the company--Douglas Aircraft Company.

Douglas's new commercial program, known as the Advanced Transport Medium Range (ATMR) was the major concern relative to sourcing of its external manufacturing. The competitors for the lower tier suppliers are Boeing, Lockheed, the European Airbus Consortium and others. The program master index provides sections for what the company terms "market success assumptions," and the report is broken into eighteen subjects, including

- (1) A design engineering management plan
- (2) A manufacturing plan
- (3) Product support plans
- (4) A subcontracting plan

Because of the heavy termination liability involved and heavy development costs, the company plans to externally source more than the normal amount of manufacturing for this new aircraft. This makes vendor

base capacity planning even more important than on past aircraft. Procurement personnel have developed a detailed listing of equipment being used on the aircraft, such as the thrust reverser cowl operating system, integrated air turbine drive, ram air turbines, and main landing gear upper and lower cylinders. Scores of these equipment items are also broken down into a detailed assembly listing together with the names of the vendors who will be providing them. In most cases the vendors are single sourced. Major assembly items are also categorized by vendor, location of vendor, and cost weight percentage (the key way in which aircraft are priced-- a per pound basis). Some of these data are illustrated in Figure 90 .

Douglas materials planners have also done the same exercise for the proposed Boeing 757 and 767 competitive aircraft, for the A300 Airbus, and others. The breakdown also shows the sources used for all components for the complete aircraft. A brief example is shown in Figures 91 and 92 . Vendor names have been left off at the request of the company. These figures show the first level of detail for this breakdown only.

Another company did vendor base capacity analysis by developing an examination of machining capability of vendors. In this plan the company combined purchased parts and purchased labor into one common data base. Everything was converted to a common base of hours at \$25 per hour. Machining was categorized into general, 3 and 4 axis, and 5 axis. The company requested suppliers to identify hours available per month through 1982, using "tried and true suppliers" only. The result is shown in Figure .

As a result of this latter machining industry capacity study, the options reviewed by management were:

- (1) Take no action now and recheck the situation in a year
- (2) Negotiate a contract now for next year's hours
including: a no charge termination at a point in time
a penalty per hour only if other work is not available
a penalty for labor plus profit only
- (3) Contract for safety factor hours only

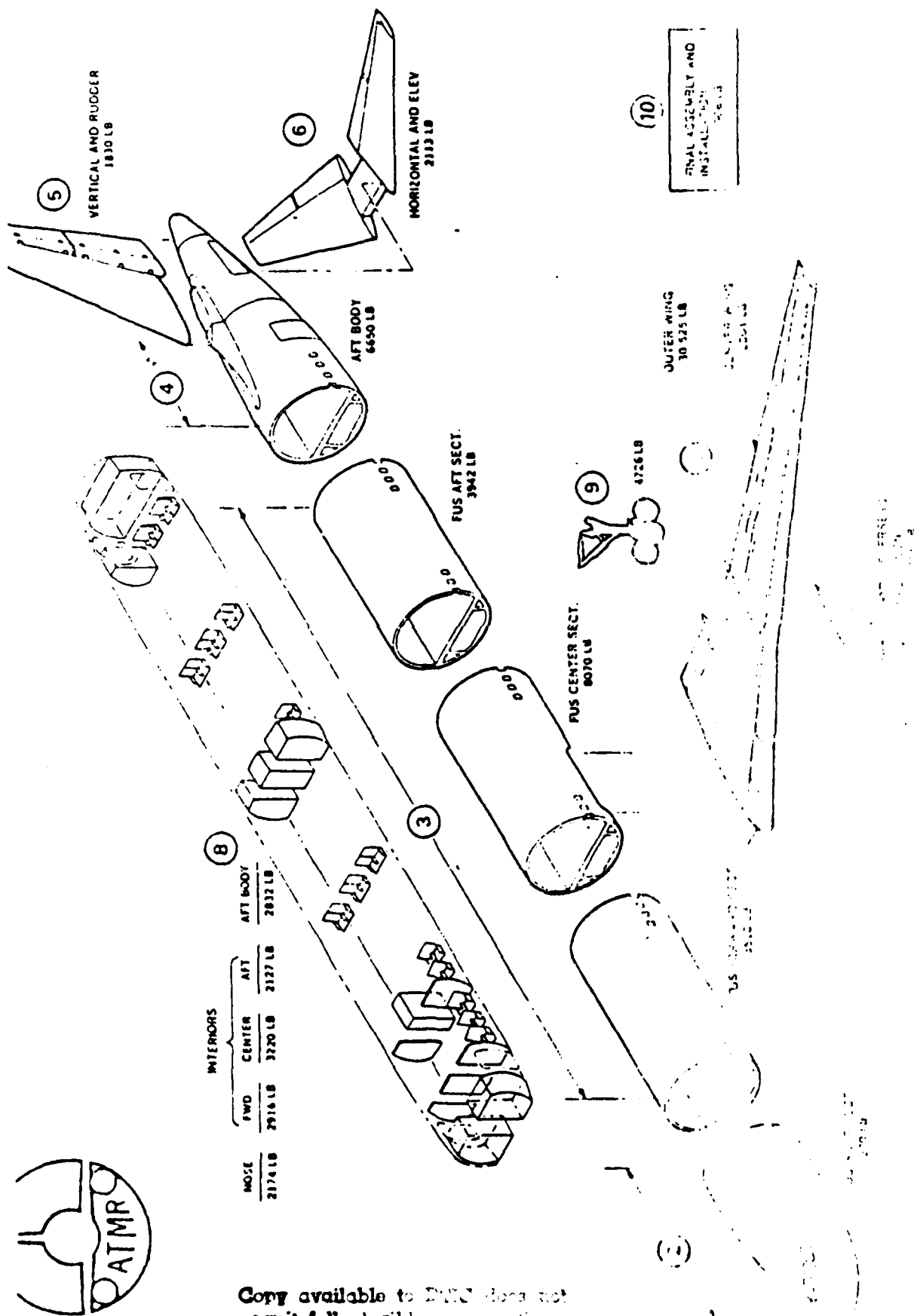
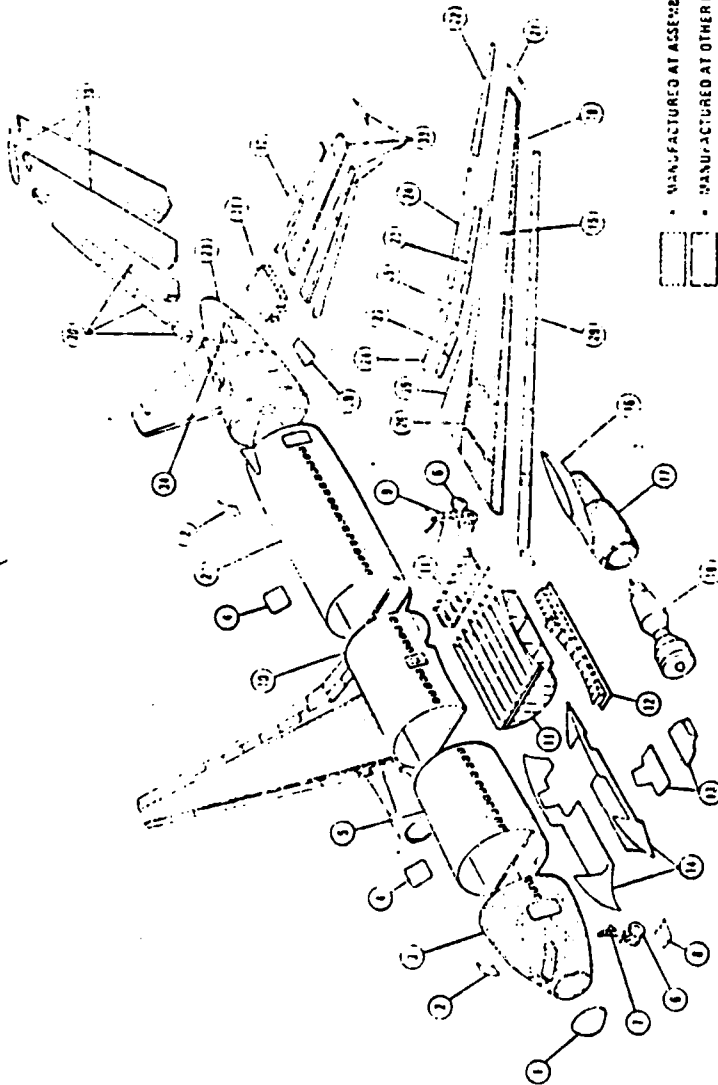


Figure 90: Exploded diagram for internal and subcontract manufacture



■ MANUFACTURED AT ASSEMBLY PLANT
 ■ MANUFACTURED AT OTHER BOEING PLANTS

PERCENT
 19.56
 2.25
 22.87

MAJOR SUBSYSTEMS / ITEMS	VENUE	LOCATION	COST PER UNIT (1000)
1. FUSELAGE	PHILADELPHIA PA	PHILADELPHIA PA	100
2. MAIN FUSELAGE DOORS	PHILADELPHIA PA	PHILADELPHIA PA	200
3. NOSE SECTION	PHILADELPHIA PA	PHILADELPHIA PA	100
4. CARGO DOOR	PHILADELPHIA PA	PHILADELPHIA PA	100
5. FORWARD SECTION	PHILADELPHIA PA	PHILADELPHIA PA	100
6. WING	PHILADELPHIA PA	PHILADELPHIA PA	100
7. NOSE LANDING GEAR DOOR	PHILADELPHIA PA	PHILADELPHIA PA	100
8. MAIN LANDING GEAR	PHILADELPHIA PA	PHILADELPHIA PA	100
9. CENTER SECTION	PHILADELPHIA PA	PHILADELPHIA PA	100
10. CENTER SECTION	PHILADELPHIA PA	PHILADELPHIA PA	100
11. WHEEL	PHILADELPHIA PA	PHILADELPHIA PA	100
12. MAIN LANDING GEAR	PHILADELPHIA PA	PHILADELPHIA PA	100
13. WING FUEL TANK	PHILADELPHIA PA	PHILADELPHIA PA	100
14. WING	PHILADELPHIA PA	PHILADELPHIA PA	100
15. ENGINE	PHILADELPHIA PA	PHILADELPHIA PA	100
16. ENGINE	PHILADELPHIA PA	PHILADELPHIA PA	100
17. ENGINE	PHILADELPHIA PA	PHILADELPHIA PA	100
18. ENGINE	PHILADELPHIA PA	PHILADELPHIA PA	100
19. ENGINE	PHILADELPHIA PA	PHILADELPHIA PA	100
20. ENGINE	PHILADELPHIA PA	PHILADELPHIA PA	100
21. ENGINE	PHILADELPHIA PA	PHILADELPHIA PA	100
22. ENGINE	PHILADELPHIA PA	PHILADELPHIA PA	100
23. ENGINE	PHILADELPHIA PA	PHILADELPHIA PA	100

Figure 91: Sourcing listing for major subsystems and assemblies

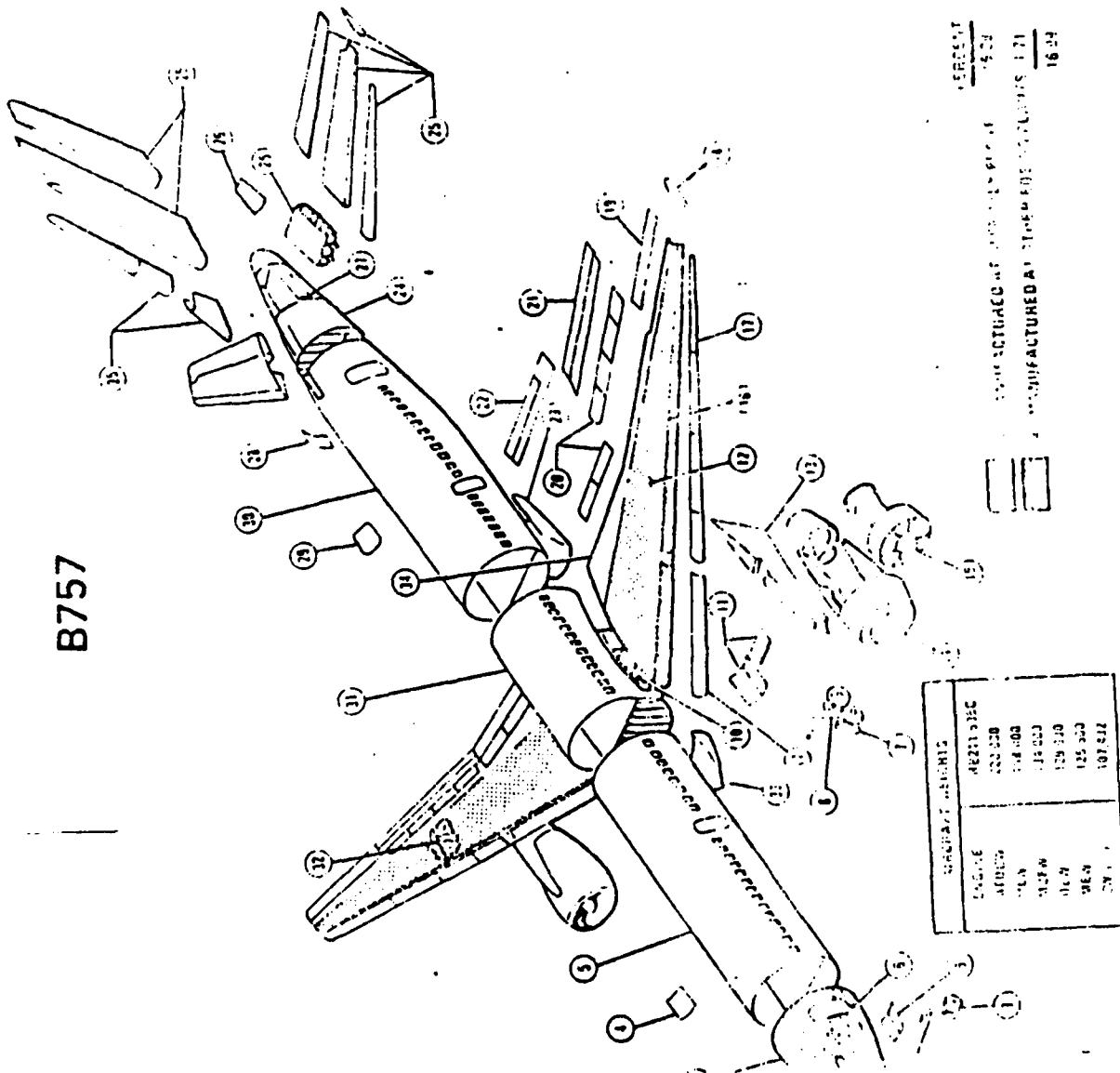


Figure 92: Exploded diagram for competitive source planning

Boeing 757 Major Assembly Vendor Listing

Major Assembly Items	Vendor	Location	Cost/Weight Percent	Cost/Weight Dollars
1. Radome				
2. Galley Door				
3. Nose Fuse Section 41				
4. Cargo Door				
5. Fuse Section 43				
6. LWR FUS Cockpit area				
7. Wheels and Brakes				
8. Main and Nose Landing Gear				
9. Nose Landing Door				
10. Center Wing and Keel Beam				
11. Main Landing Gear Door				
12. Wing Halves				
13. Engine Support Strut				
14. Engine Pod				
15. RB211 -535C				
16. Leading Edge				
17. LE Wing Slats				

Data Deleted at Request of Company

Wing Tip
Aileron
Graphite Spoilers
Outboard TE Flaps
Inboard TE Flaps
Aft Fairing
Horizontal Section 82 and 89
Vertical Section 70
APU Access Door
APU
Passenger Door
e t.

Figure 92 : Continued

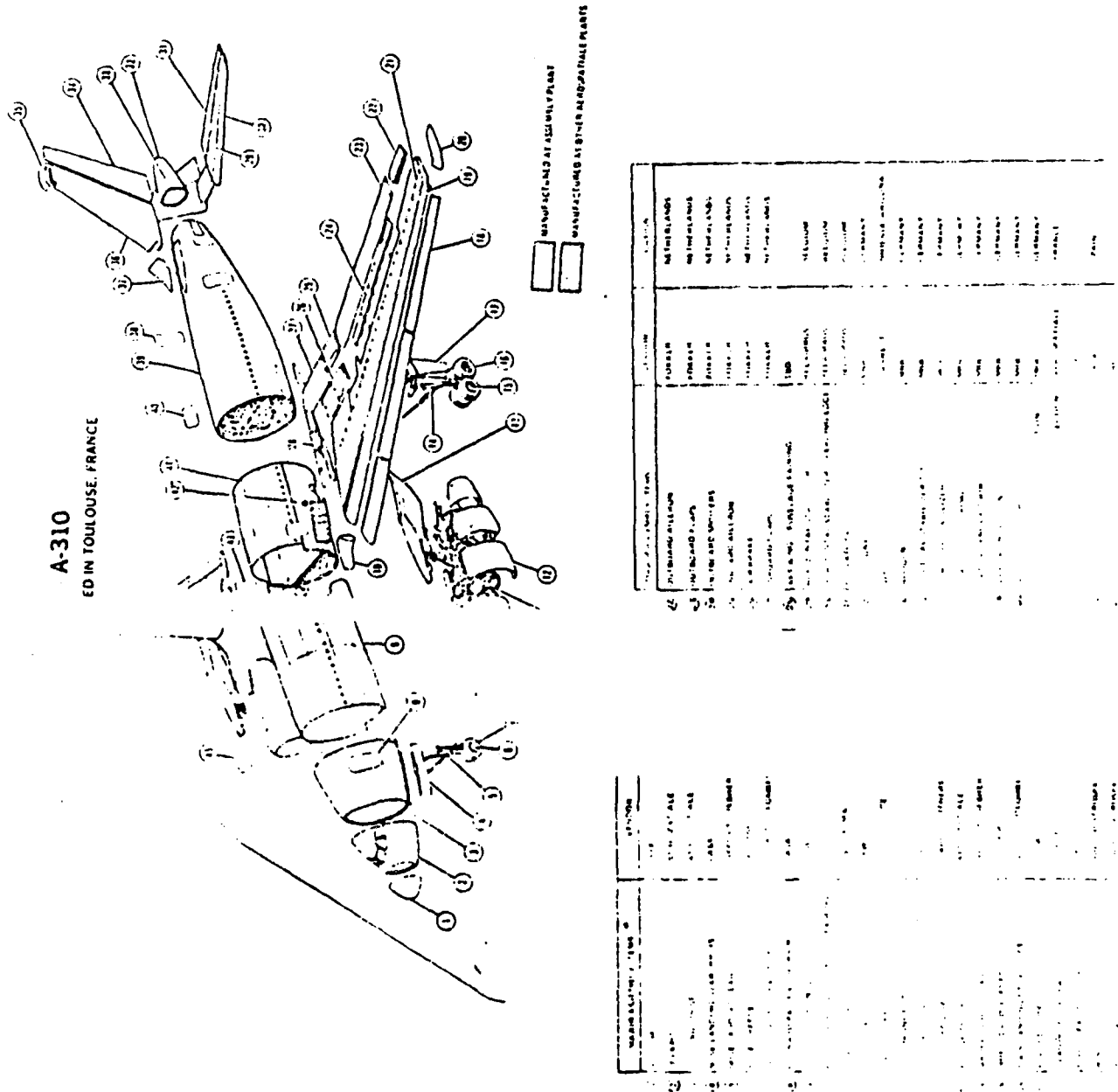


Figure 93: Competitive sourcing diagram and listing

(4) Use of other safety factors.

The recommended and adopted course of action was that the contractor agreed to 70,000 hours per month for 1980 with an option for 1981 guaranteeing 35,000 hours per month at a negotiated rate. The supplier agreed to supply 35,000 per month with no penalty. The agreement was that the buyer was not to place a purchase order until required and the supplier agreed to notify the buyer prior to committing the hours elsewhere and when the supplier could no longer hold the hours open.

Such relationships agreements can come from careful analysis of contingencies and threats and through entrepreneurial negotiations for the benefit of both parties. This study also focused on competitive buying strategies of other companies who had contracted for machining hours to determine whether these competitors were trying to (1) place specific jobs for a long term, (2) buy hours per month, or (3) tie up specific machines. The strategy document addressed specific competitive buyers of machining time within the industries using that time. Figure 94 shows the available and required hours for general machining through 1982 which were extracted from this study.

The conclusion drawn in this study was that although capacity was available at the point in time of the study, specific large competitors were rapidly tying up all competent machine sources, and that increased sales would "dry up" remaining sources. As a result, the company knew that its programs had to commit monies immediately in order to keep from impairing schedules. All purchased machine parts were placed on order at the conclusion of the study through several years in the future. The maximum exposure undertaken by the company, without firm commitment from the government, was estimated in excess of \$2 million.

In other areas the company contracted for safety factor hours only and bought 3000 hours per month with options to go to 9000. It also contracted with two additional suppliers for 1000 hours each per month.

GENERAL MACHINING

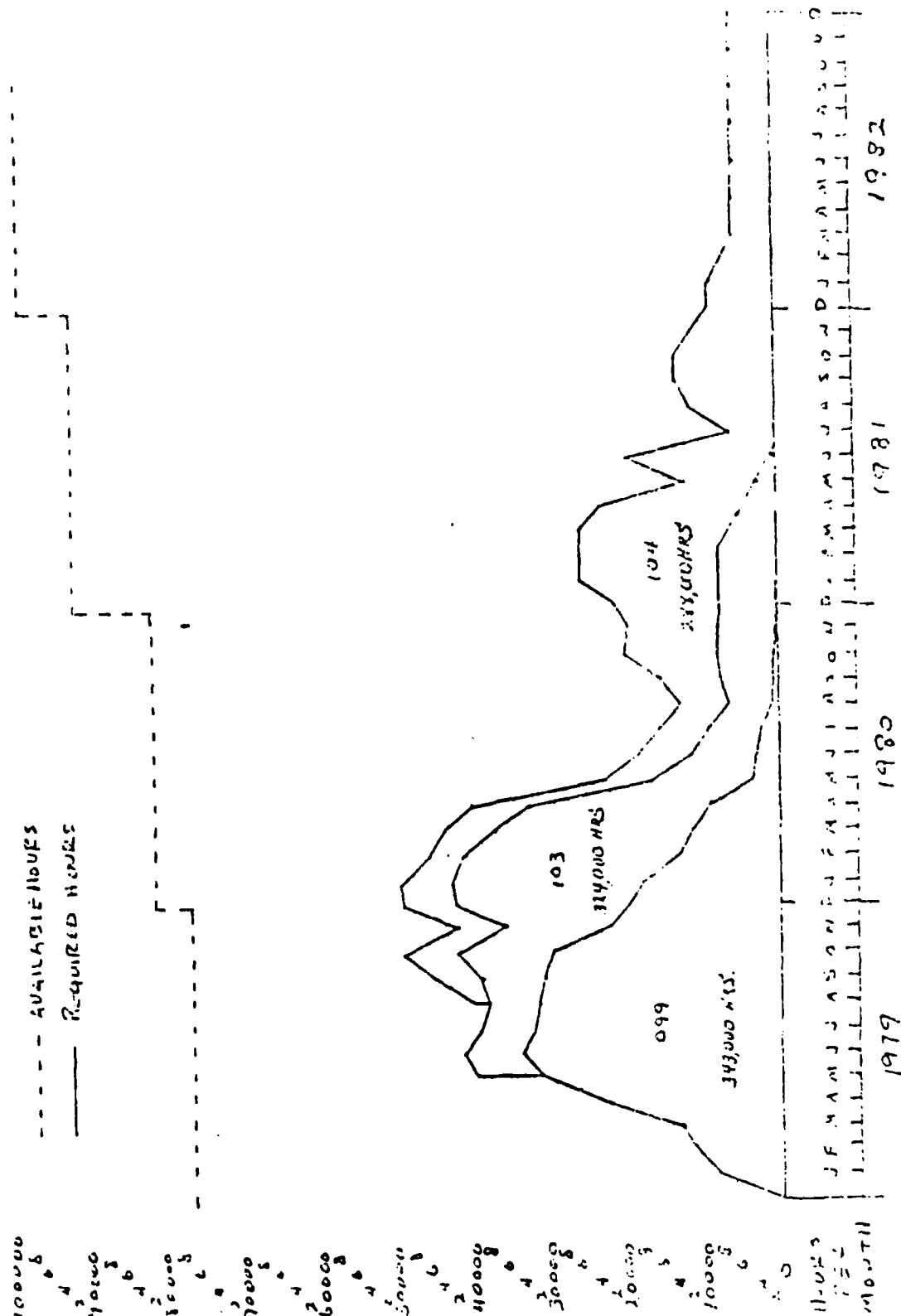


Figure 94 : Analysis of machining hours available and required from vendor base.

Purchasing strategy also called for level loading of suppliers, categorizing of suppliers by bed size, milling versus lathe, and numerical control (NC) versus pattern facilities. This had not been done before. As suppliers reached capacity they were dropped from the bidders list if a previous arrangement had not been made. The prenegotiation of the purchase orders focused on rates per hour, terms and conditions, and actual quantities were settled later.

External Manufacturing Technology Investments

Doing studies and forecasts of resource market situations is one thing. Making contractual commitments with suppliers to assure capacity is another. Making investments in supplier facilities or sheltering investments in such facilities is still another. This section focuses on initiatives to expand and improve the manufacturing facilities of external suppliers, including manufacturing technology enhancements.

Vendor Manufacturing Technology Investments

Prime contractors take a very limited role in direct influence for manufacturing technology programs of suppliers. Although most suppliers take no role at all, among those who do the approach used involves the inclusion of manufacturing technology requirements in formal solicitations. That is, where a manufacturing technology currently possessed or planned by a potential supplier is determined as inadequate, materials manager include the required manufacturing capability in the specifications during the solicitation. As one materials manager put it, "They either make the changes necessary or don't reply to us." Often such improvements in manufacturing facilities, if agreed to by suppliers, come only after receipt of a contract. But in several cases, companies reported that they could not get vendors to make such improvements strictly for military production without contracts beyond one year.

Four of the companies studied related experiences at having vendors visit their facilities to inspect manufacturing technologies and to look at plans for technology investments over a five year planning horizon. Such visits often provide a motivation for suppliers to make similar investments, since the prime contractor demonstrates his risk-taking commitment and the requisite confidence in down-stream programs required to make such investments. The following quotation was made by a manager who had a fairly active manufacturing technology investment program:

You take a company like Nuclear Metals, and they put in eight million dollars in capital equipment for producing depleted uranium type penetrators almost exclusively for our contract. They are a very active supplier in the man-tech area. Another company has put in a man-tech investment in helping us manufacture cartridges. In both cases it is fairly sure business, and we have a high degree of confidence in DOD and Congress supporting these programs. In the latter case of the cartridge manufacture, it represented some 60 percent of the supplier's business. We made commitments to them in terms of single sourcing in return for certain man-tech investments which they made.

Our strategy is to reduce their risk by being less opportunistic to recompute the business. In the long run you don't give up anything. You make it easier and less expensive for him to operate, contrary to a lot of people's beliefs. Most vendors want to deal on a decent margin, and won't take advantage of a single source relationship.

However, it takes an upper management in your own organization that will allow you to operate under these kinds of guidelines. They don't require you to come in and say "look at all the money I saved this year in procurement by bidding off vendors against each other," but they allow you to look at long term agreements with a vendor as part of a strategic plan. A program manager cannot be sympathetic about paying an initial premium to anyone, since he is trying

to win next year's contract with the government on a price basis.

Most contractors studied were not very active in trying to get suppliers to make manufacturing technology investments beyond those necessary to produce the quality level required in the specification or to get them to invest in capacities required. Manufacturing tech-needed to enhance productivity or reduce costs was considered by most managers as "pressured by the marketing system." That is, it was presumed that suppliers make these investments in order to remain competitive, and that those who do not, drop out of the industry. No thought appears to be given to an entire lower tier industry being neglectful in manufacturing technologies due to customer buying policies or to problems which would not provide incentives for such investments.

The following quotation represents the position taken in another company:

Once every six months we take all market forecasts and technologies and present them all around the nation to have the information available to suppliers and get them to see the possibilities. Usually it is done on trust and what we forecast is considered as accurate. However, when it comes to obligations, our subcontracts have no provision for man-tech, although we allow depreciation or profit incentives. We make an improvement curve using our own in-house experience on similar manufacturing and then negotiate a line item.

In the aerospace and military markets, we do not go out several years and turn subcontractors on with our own dollars. History has its ups and downs, and we cannot afford to do that. We work with the government providing leadtime information and knock on their door for long lead funding when it looks like vendors are not going to make capacity expansion investments without it.

One prime contractor commented that its major DOD program involves state-of-the-art production in castings and considerable technological change in manufacturing. Both this prime contractor and several of its suppliers are working on technology for thin wall castings, and have

built an entire program in conjunction with ALCOA for this effort. ALCOA committed itself to facilities change to permit thin walled castings.

There was a general feeling among managers surveyed that the aerospace operations have less leverage with suppliers than do commercial operations when it comes to pushing manufacturing technology investments. As one manager indicated of supplier relationships over aerospace/military business:

All we can give is verbal encouragement. We try to encourage them to change the state-of-the-art, even advance it, so they won't lose out later. We say that this should occur, or they will probably not be the low bidder next time. They may or may not believe this.

We don't have a formal subcontractor manufacturing technology improvement program, but should have. It is reviewed during source selection and that is all. The way we deal with problems of potential atrophy of manufacturing technology among lower tiers is through our product assurance program. We make sure we get the quality and specifications we need, and if this means they make investments, we sometimes share in the risk through increased progress payments.

Satellite Manufacturing Facilities

One of the prominent examples within the aerospace industry for manufacturing technology investments for productivity-enhancing performance is the satellite plant program. Although this is not directly a procurement issue, many of the satellite plants produce items which are now internal manufacture instead of subcontract manufacture, thus providing an indirect lower tier man-tech program. This section discusses some of the examples of satellite plant investments, focusing largely on one major DOD contractor that is most heavily involved in this type of operation.

As noted earlier, satellite plants are often built in lieu of subcontract manufacture. Some six satellite manufacturing facilities reported to a divisional manufacturing director in one company. The following views were expressed by one of the satellite plant manufacturing technology experts that was interviewed:

The company appropriated over \$200 million for satellite manufacturing operations so far. The plants are being used because they are relatively smaller, have highly specialized technologies and are easier to control and manage. We use a concept called grouping technology in setting up these plants. There is a significant reduction in manufacturing leadtime in these smaller plants as well as a reduction in manufacturing costs. The average productivity is some 20 percent higher than in traditional operations. Parts and components produced in a single plant are highly similar and require the same manufacturing equipment. Production is for both commercial and military programs in these plants.

The decision to invest in these plants was a function of both the tremendous upsurge in commercial sales and our view of the military market. A particular military program has been good to us, and we are putting more automated equipment in these plants and it is much easier to produce new technology there. People can see all the similarities among operations required and can streamline them and balance the workload. Because it is new, the unions have not seen all the traditions of an old plant. We can introduce new processes and equipment into the plant, and we are not eliminating any jobs or competing against people.

All this is done with company money, and we are no longer in a mode of utilizing any government money for it, except where special applications are required. Sometimes the government customer will purchase a special machine for a given weapons system. Although we have about 40 percent government business, we are spending company money with the risk of getting payback on that portion of our business.

One example of new technologies being installed in satellite plants is computer controlled laser drilling. The company has a lot of CAD/CAM in the plants and plants are often linked together and to computer centers throughout the world in a network of interlinked operations.

As a result of these investments, companies are bringing in-house many operations which had formerly been subcontracted. The termination liability becomes part of the program of the investment and is included in financial analyses. Each satellite plan has a specific appropriation plan including upside and downside risks. The following scenario describes one manager's view of this decision process:

We describe the worst case and the best case and work out what the liability is. In order to get the economies of scale, each plan works on several products and we do a strategic, long range plan using the programs we expect and the probabilities of those programs in the future and the present value of the proceeds involved. There is always a cross utilization of these plants and multifunctional product/program appropriations to fund them.

Most of our orders, except in military contracts, we consider at least "semi-firm" and in several cases commercial customers have given us long leadtime funding to help building satellite plants. Some customers have options stretching to 1985 based on this funding assistance.

We have also included in the plants an advanced materials handling system, some thirty feet high with narrow aisles and an unmanned computer picking items from "pigeon holes" in stacks. This is integrated with our robotics carrier system and computer controlled transfer to production. All work stations are also computer controlled, including materials transfer to and from stations. We are merely copying a system we saw in Japan and in Germany, however.

Management indicated that in foreign satellite plant operations, production was not merely for sales in that country, but also included components for shipment abroad. Financial analysis for satellite plants included global market analysis and sales expectations. As one manager commented, this provides the country with an "exportable offset." Offset programs used by American DOD contractors have served as key areas to spawn ideas for satellite plant operations. In many cases these offset-based ideas have been coupled with corporate strategic mandates to improve productivity by as much as 20 percent.

In several companies manufacturing technology proposals aimed at satellite plant investment in lieu of contract manufacture come in each year based on a financial horizon of several years for payback. They typically focus on improving the company's competitive position from a productivity standpoint. Most of these plans and satellite production make/buy proposals are contained in corporate or divisional strategic plans.

However, robust market opportunities are usually required to shelter the risks, as one manager commented:

We know we have to increase capacity for these parts and components due to the market and the projected sales increases. The market growth is the umbrella over the investment. You pick out those parts which you presently are paying a premium for in subcontract manufacture, then look at their use in growing programs, and then make a decision to create a satellite plant for them.

Often this is used in negotiations with subcontractors to get them to make the investments, since they know that if they don't we will and bring it all in-house.

Some of the products we buy from suppliers have quality control problems which initiate the analysis. Take, for example, nickel-based alloys where small impurities can cause major drops in the properties of the alloys. We had to do a lot of work to help a supplier produce powder against our specifications and this required him to be on the cutting edge of manufacturing technology. Either he did it, or he lost the business and we took it in-house with a new satellite plant.

We encourage our procurement people to look ahead three-four years and if they find areas that are cost drivers or potentials for delay, they ask for a study of internal manufacturing technology investment. We do a study and use this to motivate the suppliers. We have been known to give a manufacturing process to our vendors to get them going.

Several contractors indicated that manufacturing technology work is done in conjunction with R&D effort, some of which is under contract with DOD agencies. One company mentioned that it had a Navy contract to look at manufacturing technologies for high speed machining of shop screws. However, most manufacturing technology--both in-house and in lower tiers-- is pushed by the need to pursue advanced technologies in components--particularly materials. A large portion of manufacturing technology investments occur in support of the "advanced development phase" of a program. One company manager commented:

We get a better strength to weight ratio before DSARC I and to do this we went out to get composites. However, some expenditures have a very general application, such as high speed machining. Often, though, we try to get a line on what will be needed in advanced development and make the man-tech part of the proposal for funding in this phase of a DOD program.

In one company, manufacturing technology programs come from specific committees or councils which focus on problems. One example is a corporate productivity council. This council has representation from a manufacturing resources office under the title of "Manager of Advance Requirements and Operational Planning." The office recommends capital investments for manufacturing technologies, including make or buy studies. According to the management in this company, these programs carry the same "responsibility" as do research dollar proposals aimed at performance technologies. They are funded from company money, but in military contracts they have a depreciation item allowed as overhead. The manager commented:

When items are subcontracted, we always include an analysis of vendor man-tech investments and capabilities in our facilities review. Where deficiencies occur and cannot be remedied directly in negotiations, we do an internal study of doing the production in a satellite plant, particularly if it is a critical item.

Several of the corporate and divisional strategic plans addressed manufacturing technology as a strategic issue, but almost none--only four--addressed lower tier manufacturing technologies. One manager commented that he could not remember ever trying to drive a vendor in manufacturing technology investments.

F-16 Technology Modernization Program

One major example of internal manufacturing technology investment wherein DOD has been a major participant is the F-16 program at General Dynamics, Fort Worth. This section presents the results of a discussion of this program with General Dynamics personnel, as well as related strategic resource market management efforts in this area.

Initially the plan for the program was for General Dynamics (GD) to modernize the F-16 plant for \$16 million, with the Air Force to provide a continuing modernization program at \$50-250 million. After the award, Air Force policy dictated that government funding of machinery and production equipment was not feasible, according to GD. However, the existing contractual arrangements did not provide financial incentives or rewards for additional investment in the eyes of GD managers. Figure illustrates the GD investment and cash flow analysis for investment in a profile mill-5 axis 3 spindle machine.

According to GD managers, new contracting methods and initiatives were needed to encourage capital investment and combat rising costs that resulted in fewer procurements made at greater time intervals. The F-16 manufacturing technology program was offered as a possible solution. This program was based on the assumption that GD would provide a sound business base at a reasonable rate for a significant number of years.

Secondly, financial incentives permitted more dynamic facility acquisition, and technology development guaranteed productivity enhancement as the payoff mechanism. Investment protection and incentives were handled through the following:

GENERAL DYNAMICS INVESTMENT - CASH FLOW ANALYSIS (Profile Mill-5 Axis 3 Spindle)

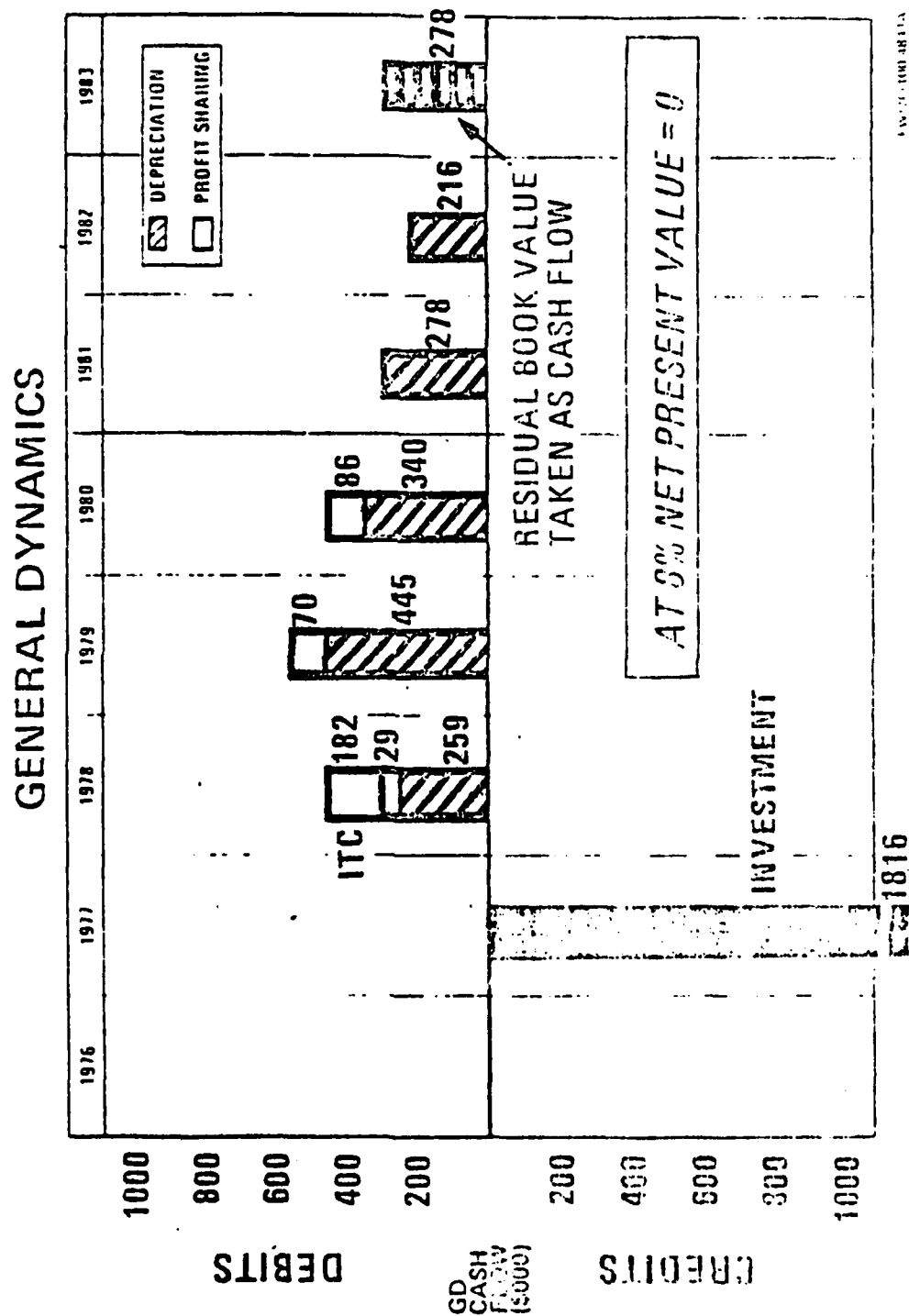


Figure 95: Investment/cash flow analysis for manufacturing technology

- (1) Depreciation payment on previously unforecasted facilities
- (2) Investment tax credits
- (3) Cost of money included in financing of contract
- (4) Termination protection

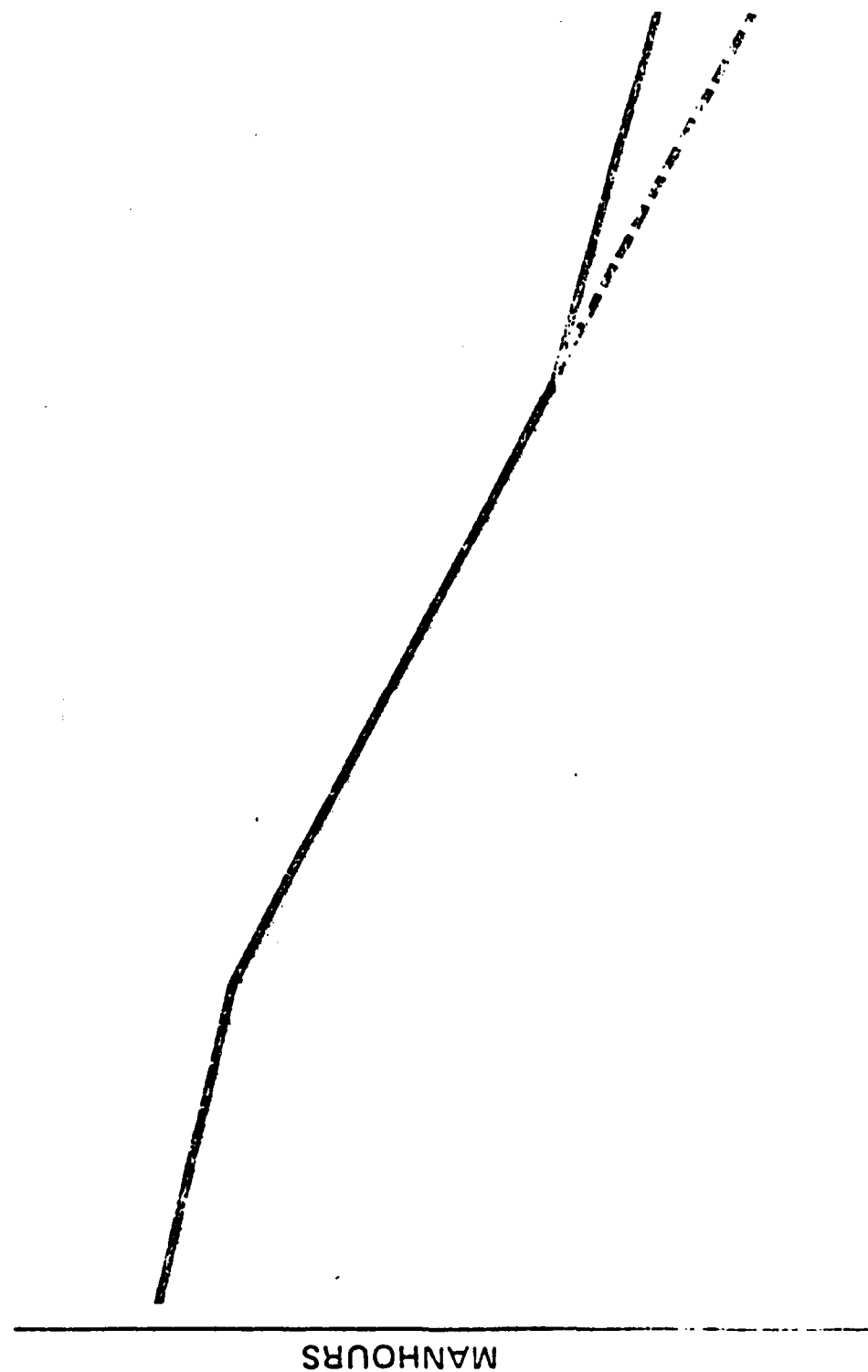
Incentives were made through an award fee provision and investment incentive profit for facilities investment, facilities implementation, and savings performance. Figure 96 illustrates the planned relationship to shipsets volume (aircraft levels produced) and manhours per shipset. The return on investment under normal contracting, according to GD management, was eight percent. Management felt that risk reduced the ROI further because of no guarantees in production runs. Under the technology modernization program, the ROI was targeted at 15 percent. Figure 97 illustrates GD's version of the program mechanism.

The modernization program strategy involved establishment of a cost baseline at the detailed level, analyzed to determine areas with potential for an increase in productivity provided that specific facilities and technology applications were made and they achieved their goals. Labor costs were identified as most suitable for productivity improvements as shown in Figure 98 .

The F-16 man-tech program features were as follows:

- (1) Conceive concepts to improve the producibility and increase the automation of F-16 manufacturing.
- (2) Begin development activities in the primary factory cost centers for fabrication, subassembly, and assembly to improve the manufacturing processes, development and implementation of group technology, and increase the utilization of computer-aided manufacturing.
- (3) Associate production and assembly processes into cells to reduce handling and transfer delays through expansion of factory rearrangements such as linear flow areas, more effective management information systems, and identification, justification, and implementation of capital facilities as required.

Modernization Improves Productivity



SHIPSETS

Figure 96: Modernization improvement diagram

Technology Modernization Program Mechanism

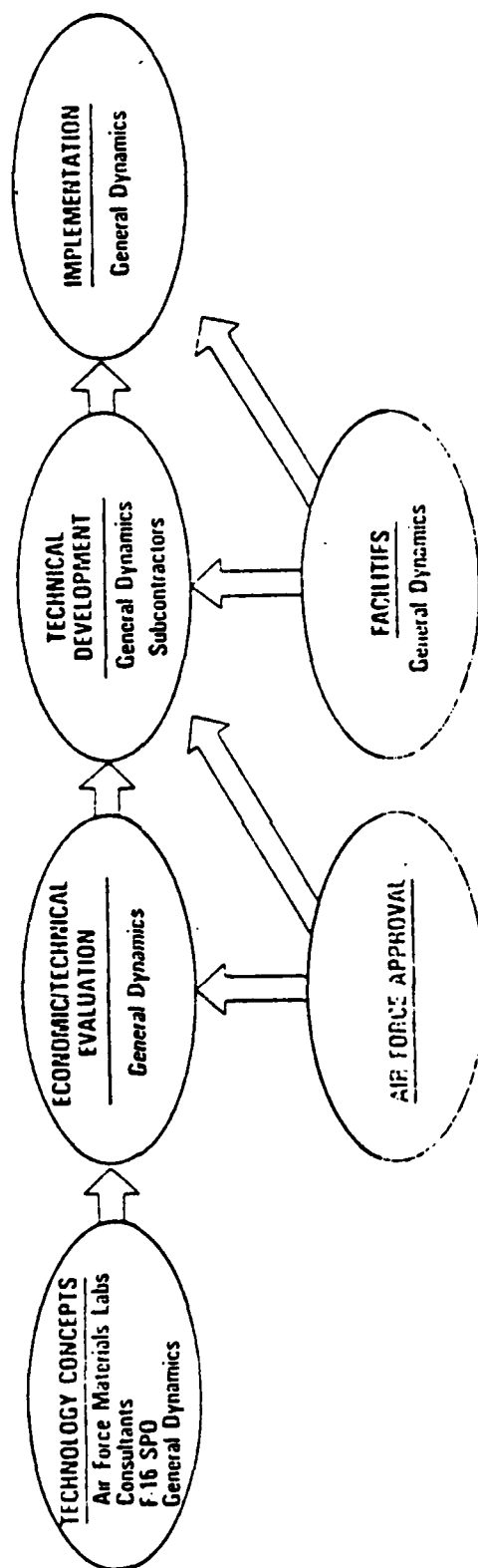


Figure 97: Manufacturing technology program mechanism

Labor Costs Were Characterized to Identify Most Suitable Areas For Productivity Improvement

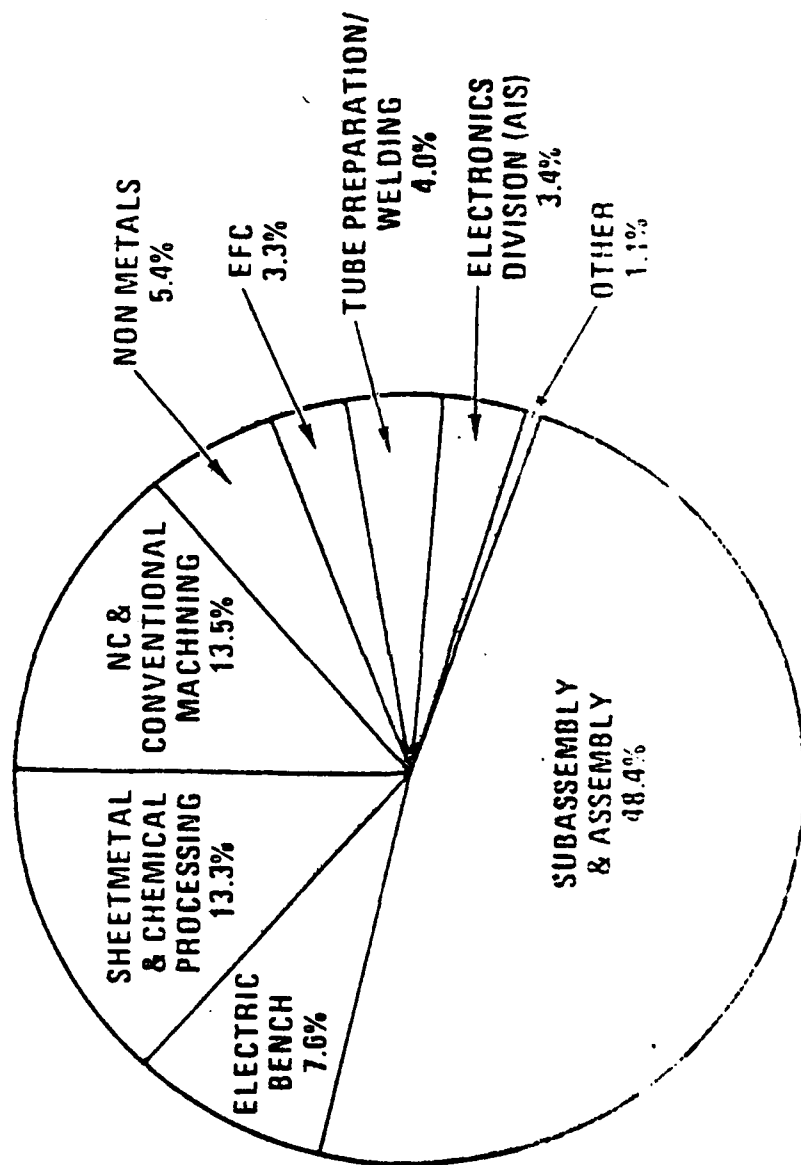


Figure 98: Labor cost productivity targeting

Program financial status shows an investment of \$25 million in USAF R&D monies, with \$11 million committed through 1979, and \$14 million to span through 1983. Some \$103 million in planned capital facilities by GD with \$60 million committed through 1979, and the remainder planned through 1985 also occurred. Areas of productivity enhancement are illustrated in Figure 99, with selected examples focusing on routing and drilling of fuselage panels.

In conclusion, GD indicated that the program was practical and provided a sound and workable example with incentives that were sufficient to provide contractor motivation and significant productivity improvements. The F-16 program did not include any lower tier man-tech efforts or any major "make" decisions. However, some operational procedures still need improvements, according to GD management:

- (1) Though savings are significant, they are not easily identified in relation to total aircraft cost by conventional means.
- (2) Current systems management is not sufficiently flexible to accommodate program changes.
- (3) Multi-phased development contracts caused irregular program pacing.

However, according to GD, the program "marks a milestone in new procurement policies recognizing needs for increased guarantees of production, increased contractor capitalization, integration of manufacturing development and facility procurement. We are still working with the Air Force to improve contracting arrangements, but the technology modernization program is expected to reduce the F-16 manufacturing costs by more than \$220 million."

This program also provides an example whereby similar investments could be made in major targeted lower tier manufacturing technologies. Similar to the F-16 program, these efforts could focus on basic machine tool requirements that would permit rate production. During the initial stages of full-scale development, both the Air Force/DOD agencies and the prime contractor can recognize areas of improved productivity through investments. The major problem is getting a program with sufficient down-stream credibility, such as the F-16--to provide contractors with incentives to make matching investments. Further, flow-down provisions

Routing and Drilling Fuselage Panels

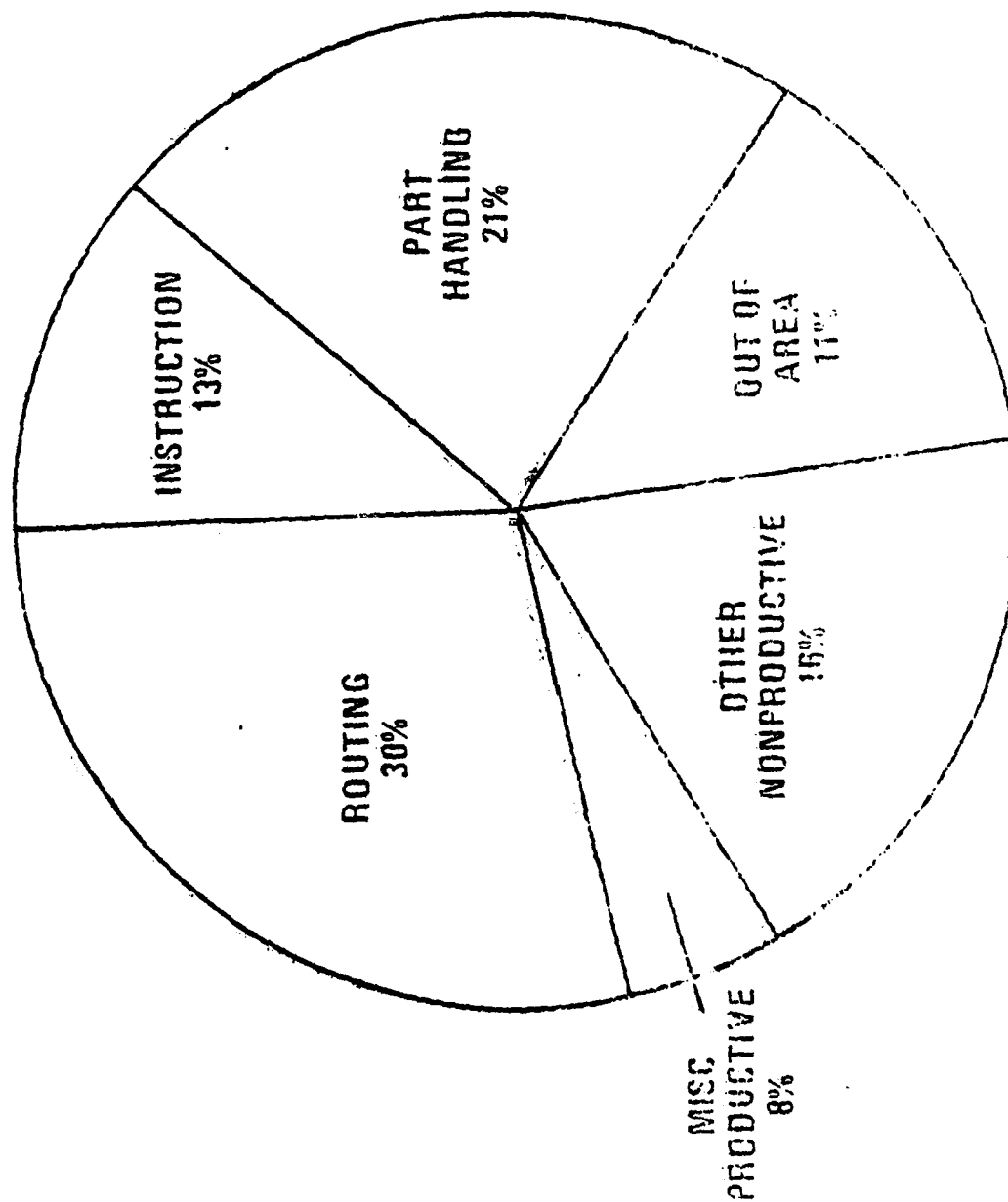


Figure 99: Routing and Drilling fuselage panels

must also provide for lower tier contractors the economic incentives shown in the F-16 program. Major program steps used in the GD program could also be followed:

- (1) Identification of manufacturing areas in lower tier production for most fruitful cost reduction in direct labor based on the major criterion of achievability.
- (2) Apply innovative approaches, such as technology development and equipment designs, to achieve cost reductions.
- (3) Verify factory compatibility for new facilities and process improvements through planning changes, tooling modifications, and preparation of three-dimensional factory layouts.
- (4) Development of the necessary technologies and timely procurement of appropriate facilities.
- (5) Implementation of improvements in production environment
- (6) Assessment of program effectiveness through cost tracking and analysis.

Achievement of a program baseline can be done through comprehensive evaluation of detailed parts fabrication, such as electric harness fabrication and assembly, manufacturing assembly of external and in-house produced components and test equipment, and final assembly analysis. Specific cost drivers must be identified in lower tier production and the contribution they make to total manufacturing cost must be evaluated. In the F-16 program, most of the manufacturing costs were in subassembly and assembly (48.4 percent), while a large amount was also in the numerical control (NC) and conventional machining (13.5 percent), sheet metal and chemical processing (13.3 percent), and electric bench (7.6 percent).

Often specific "enabling technologies" must be developed in order to increase the state-of-the-art in a manufacturing technology to attack a specific cost driver area. For example, in the F-16 some twelve of these areas were identified and funded. Enabling programs can be funded by the subcontractor, the prime contractor or the customer or in balanced amounts. The areas of technology development for the F-16, which was jointly done with the Air Force Materials Laboratory, included programs in integrated CAM, producibility/assembly, materials technology, quality assurance technology, nonmetallics, and wire harness.

The GD facilitization and investment for cost reduction program also included major efforts by subcontractors. The subcontractor planning package involved using their own B&P funds and a planned package that was subjected to final approval by GD. Implementation of this package has not yet occurred.

Resource Market Management for Mobilization

Of all the areas of resource market management, the least developed and implemented among contractors is mobilization surge planning for lower tier supply capability. Virtually no company studied was doing resource market capability planning, much less development and maintenance of capabilities to supply surge levels. The targets used for planning are merely those in the Five Year Defense Plan and those which the companies expect will really survive and be funded under a peacetime scenario. Wartime mobilization levels of demand are not planned for in either strategic sales objectives or in manufacturing support.

As one manager put it to the authors:

Even the mission element need statements you see are not written with any mobilization scenario, but are based on a peacetime environment and attrition level.

Most of our planning risk is not that of our ability to compete as a prime contractor, or even in our risk to get business supplies from somebody else, but in whether or not the government will proceed with a program. If you factor in wartime needs, the probabilities for planning for this are so low, you are fooling yourself. When you are not sure if a program will really go or not for peacetime levels, you certainly can't plan for mobilization levels.

Our perceptions of vendor and lower tier planning is that if they are sure they will have, say, an FX, they will plan and provide some Y capacity for what they feel will be the level that Congress will fund. Planning is for expected probabilities of Congressional funding, not for mobilization ideas.

Another manager indicated that much of the inability to produce to a surge requirement comes from a current constraint due to high

commercial demand levels. As he put it:

I read that Boeing has a \$23 billion backlog saturating the industry. If it is not for a booming Boeing, there would be adequate capacity in lower tiers for much of the defense needs. Industry is reluctant to facilitate to a peak. For example, in the mission of the cruise missile launcher platform, a supplier wants a translation into how many blind titanium fasteners we are talking about and we cannot answer him. Yet you know they are one of the longest lead time items. The design is not yet determined. So we have to talk in parameters, and we know that if it flies so high and so fast it will need a ton of fasteners, so we say we may need a half ton. That is how you plan for lower tier support on DOD business.

Lower tier capacity planning, as well as strategic planning in general, is done under the philosophy of the Congress being very austere in its posture and what is thought to be its funding potentials for the next fiscal year. If that perception is low, based on the political climate, then the lower tier industries will atrophy, regardless of efforts by prime contractors. This seems to be the main philosophy expressed by managers.

Surge planning in the commercial world is more definite. One contractor manager indicated:

We give them (suppliers) a tolerance band of a market estimate plus or minus so much and they must live within that band to have capability. On our current commercial new products, our suppliers have built up to a maximum rate of so many per month to year 1983 and it will require additional tooling beyond that. We sit down together and share assumptions, uncertainties, worries, and numbers.

Another contractor's management stated:

Yes, we assess vendor capabilities under mobilization planning scenarios, but we are a low rate production facility and the change is not much. Our suppliers could go well beyond the present level--two or three times--and have no problem. We determine what is the maximum capacity of a vendor and compare that with the government needs for the next three-four years. If we went to war tomorrow, and needed ten times the systems we are producing, I know

that somehow we would scramble and make it. I cannot plan for that level across the board, month by month, and it would be too costly to do so.

Much of mobilization planning that is occurring is in response to request from DOD agencies. As one contractor put it:

We do mobilization planning for suppliers and there are studies requested by our customers. In the case of the Navy, we are given a mobilization rate of so much per month. The premise of that is figuring out what we would do if it went to that. We then solicit information from suppliers and determine how long it would take to get to that level. I suspect we are maintaining poor mobilization capability among suppliers. The only way we could handle it would be to stockpile critical elements, and there is no funding to do that. It gives us a good deterrent to going to war when you know you don't have what it takes to do it.

A critical issue in this area of mobilization surge came from a perception from a majority of the procurement personnel interviewed that the defense production base is being forced downward all the time into lower tiers. This is in contrast to the satellite plant notion, and says that it becomes more difficult to increase a base which is being more specialized and forced into subcontracting to spread the risks. An aircraft manufacturer's management put it this way:

If the Air Force wanted to go to twice as many planes per month in this facility, we could do it. But we couldn't get the parts to do it. We would have an extension in the production cycle due to parts. Who pays for the penalty to maintain unused capacity, and if you get a titanium manufacturer to add twenty percent capacity, who allows it in your costs?

We would have to scramble, but would have a pretty good capability internally. But if you wanted to run a couple of aircraft programs at full speed and then throw in a manned bomber on top, industry would have a lot of choke points. At the program level we have no assurance of even peacetime levels, at the program level, we have poor assurance of wartime production, but on a total defense requirements effort across programs it is an impossibility, frankly.

I hear all the time about industry capacity problems. I don't see it except in certain areas, however, like forgings and castings. It is not true in a broad base, but those same few choke points will prevent you from having an airplane ready to go. It is the classic problem, for want of a nail the war was lost.

Summary

This chapter has presented the results of the research regarding management of external manufacturing resources as a part of strategic planning. It has explained philosophies and perspectives toward strategic dependency on external manufacturing facilities, various strategies for dealing with this dependency, and examples of specific programs for managing the manufacturing resource issues.

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Chapter XVI

CONCLUSIONS AND RECOMMENDATIONS

Having presented two sections discussing strategic management and strategic resource market management, respectively, including both conceptual materials and examples from the DOD industrial base, this report now concludes with a summary of the findings and recommendations for DOD policy and procedural change and ideas for further research.

Focus of the Report

Prior to summarizing the findings in the report, the authors will review the focus of the report and its charge. The purpose of this research was to assess the state-of-the-art of the strategic management systems being used by a cross-section of DOD contractors, with specific interest in the content of resource markets and any immediate and long-range efforts being employed by the contractors concerning the acquisition of strategic and critical resources. In approaching this task, chapter 1 began with three information objectives:

- (1) A report of the state-of-the-art of the strategic management processes being used by contractors
- (2) A discussion of what, if any, role that DOD and government acquisition policies and procedures have in determining the incidence and content of strategic and critical resources in the strategic management processes
- (3) A discussion of what, if any, role that strategic and critical resources play in strategic management programs.

In approaching this task the report made a major conceptual assertion that:

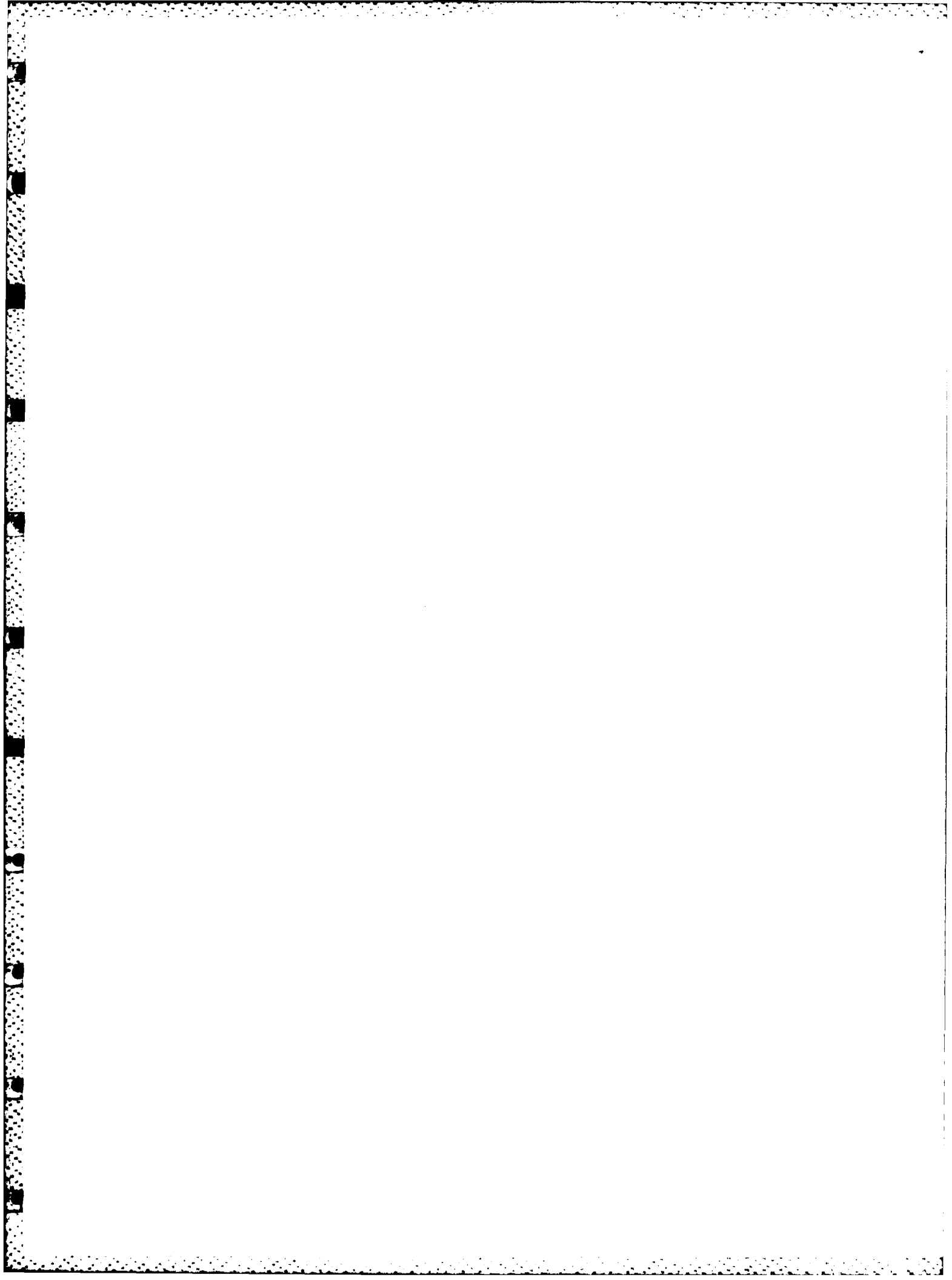
DOD Prime Contractors are aware of the strategic and critical resource concerns of the Department of Defense, specifically those listed in chapter 1. Further, these contractors not only address these concerns as part of their own strategic management effort, but they take active steps to address these problems so that they will not materially hinder their delivery of effective, affordable and timely deliverable weapons systems.

This statement is important in that it presumes that any lacking effort in strategic management of resources is not due, in major part, to lack of awareness of such strategic and critical resource concerns of DOD. That is, that DOD has done its part in alerting its contractors of its concerns and articulating them in a manner sufficient for their consideration as strategic issues by contractors. The research is based on DOD's specific concern, so it must be presumed that in assessing the industrial base's actions, this concern has been communicated.

It was noted further that the prime contractors have a key position in the multi-tier channel of supply of weapons systems in that DOD does not have privity of contract to deal directly with lower tier suppliers. Consequently, a further assertion was made:

The adequacy and performance of the lower tier industrial base organizations (the main concern of this report) is directly and indirectly influenced by their management's perceptions of the competency, thoroughness, and quality of strategic management efforts of prime contractors relative to DOD acquisitions and the opportunities of the prime tier organizations as a viable marketplace for the lower tier organizations.

This statement is critical to the report in two ways. First, no effort was made to measure the relative perception of lower tiers concerning the strategic planning/management efforts of prime contractors. Since it is presumed that this effort is important as a motivator and director of lower tier companies concerning their efforts to supply strategic and critical resources. Thus, the focus of the research was on measuring the adequacy of this strategic management effort from the perspective of judgment by the researchers, not as perceived by the lower tier suppliers. Second, since the prime contractors represent the intermediate market of the lower tier suppliers, and DOD is only an "end market," lower tier suppliers are dependent upon prime contractors as an information source and for reducing risk in market opportunities, since lower tier companies often do not deal directly with DOD.



Thus, the prime contractor operates as a key link of market opportunity to the lower tier supplier. This provided the basis for three statements defining what would be examined in the research with prime contractors:

- (1) Their ability to identify long range mission and weapons systems needs of DOD as a role in market opportunity assessment. Of particular importance is their ability to do this in a long-range, strategic perspective prior to direct award of research or procurement funding.
- (2) Their ability to acquire internal and external resources necessary to support this long-range DOD mission and weapons system needs.
- (3) Their ability to provide DOD with acquisition choices in an operationally effective, affordable, and timely manner free from constraints imposed by resource markets.

Adequate contractor performance, from a DOD perspective, involves the ability to assess external resource market issues for technological and material resources and a perspective of responsibility concerning proactive, entrepreneurial efforts toward acquiring these resources to meet the expectations of item #3 above. Specifically, this perspective of proactive responsibility extends to:

- Potentially non-available resources
- Cost containment concerning resources
- Competitive nature of the lower tier supplier base
- Capabilities and capacities of lower tier suppliers
- Direction, motivation, and orientation of lower tier suppliers concerning their own resource problems.

It is expected that this last task, that of motivation, will occur through the communication of strategic planning efforts and findings to lower tier suppliers to alert them to problems and assist them in doing their own proactive, strategic management effort.

From this introduction, two research propositions emerged:

Proposition 1

HIGH QUALITY STRATEGIC MANAGEMENT OCCURS WITHIN PRIME CONTRACTORS IN THE PROCESS AND CONTENT RELATIVE TO THE STATE-OF-THE-ART OF STRATEGIC MANAGEMENT.

Essentially, how well do DOD contractors compare with other companies in their strategic management programs?

Proposition 2

HIGH QUALITY STRATEGIC MANAGEMENT OCCURS WITHIN PRIME CONTRACTORS WITH REGARD TO RESOURCE MARKET ISSUES AND STRATEGIC MANAGEMENT OF SUPPLIER RELATIONSHIPS.

Essentially, how well do the DOD contractors manage their, and DOD's dependency on resource markets and suppliers from a proactive, entrepreneurial approach?

From these objectives and the data presented in the previous chapters, the authors now focus on the intended recommendations:

- (1) How well is implementation of strategic management occurring, and what aspects are being implemented?
- (2) What, if any, suggestions for improvement can the authors make to contractors?
- (3) What, if any, suggestions for change to DOD agencies can the authors make which might improve the contractor strategic management process?

Summary of Findings

An in-depth presentation of the findings of this research is presented in the previous chapters. The purpose of this section is to summarize these findings for readers who may not have read the entire presentation of the material and to develop a basis for the recommendations which follow.

Strategic Management Processes

In general the aerospace industry is equal to or on the forefront of the process of strategic management with respect to other industries in the U.S.. Based on the authors' assessment of the normative model of strategic planning and management presented in the numerous references

which were studied in preparation for this assessment, the authors found that several of the companies who are government contractors are the leaders in the development and implementation of management processes for strategic decision-making. Most outstanding in this area were the following:

General Electric Company
Rockwell International
General Dynamics
Texas Instruments
McDonnell-Douglas
Honeywell
Pratt & Whitney

Several other companies had significantly less developed processes of strategic planning, and a few were doing very little of this effort. It is not the purpose of this report to judge and report relatively poor performance among the contractors. The companies noted above, however, provided the authors with very state-of-the-art materials for this process, and many of those quoted and used in this report came from these companies. In two instances, the companies claimed fairly sophisticated management systems, but did not provide much evidence of this to the researchers and were comparatively conservative in what they were willing to share.

With respect to proposition 1, it is the assessment of the authors that high quality strategic planning occurs within prime contractors in the process and content relative to the state of the art of strategic management. This is particularly true for the companies noted above. Most are in phase III of the process of evolution toward strategic management, focusing mostly on planning, rather than the proactive "shape the future" approach.

In examining strategic plans with the managers, the authors found detailed examples of the use of strategic planning practices for most DOD programs. In general, DOD programs are receiving equal if not better application of strategic planning than are commercial programs.

Strategic Management of Resource Markets

Although the overall strategic management process used within the sampled contractors is equal or better than the processes used in U.S. industry in general, and many of the companies studied are examples of leadership in this management process, when resource markets are discussed, the following emerges:

- (1) Only limited, isolated efforts are occurring with respect to strategic efforts concerning external resources. These limited efforts are very fragmented within the aerospace industries and occur on a company by company, issue by issue basis.
- (2) Little, if any, overall procurement or materials management directed efforts are occurring to provide a comprehensive process for strategic planning or management of resource market issues and relationships. In general, the procurement functions in aerospace companies operate on a tactical, operating mode in support of short-term manufacturing requirements, and the management philosophy and practice relative to resource markets is very much behind the state-of-the-art concerning sales/customer market strategic management.
- (3) What, if any, strategic planning and management efforts that are occurring in aerospace companies are ad hoc in nature or are limited to just one or two issues--such as critical resource availability or manufacturing technology--and not to an overall scope and focus on identifying and strategically managing all of the various categories of strategic issues identified in this report.

In general, the state of management processes with respect to external resources is a decade or more behind this same process in the marketing and customer end of business operations. There appear to be two major factors which influence this status: First, the operational nature of the procurement function tends to be very near-term in its focus across all industries, and even though there are major strategic issues in the aerospace and other high technology industries, the focus is still on "keeping the plant running." Materials management has developed a nature of being tactical efficiency oriented.

Second, although item one provides a philosophical setting which preconditions the materials function toward tactical operation, the managerial perspective of the incumbent corporate/divisional procurement

director also appears as a major contributor to whether or not strategic management has become a part of the process being used. In many of the companies which the authors studied, materials managers appeared to be quite "shocked" or "surprised" at the suggestion by the authors of a strategic planning and management responsibility. They expressed a high degree of "unawareness" that this was a responsibility of their function. Discussion of conceptual ideas usually brought interest, but generally a lack of "having ever heard of it before."

In other cases, management seemed to see the need for what the authors call "a strategic management process," but when the materials managers were questioned, and replied that they were doing some strategic management, they produced evidence which failed to support this. Typically, strategic planning to a materials manager consists of materials forecasting and planning in terms of quantities over one year time-frame, using Gantt charts for program milestones, projecting leadtimes for a one-two year period, and other managerial skills. The conceptual approach discussed in the previous chapters of this report were, in most cases, almost completely lacking.

When the authors discussed the possible need for approaches such as those discussed in the previous chapters, in nearly all cases the materials managers agreed that more of that should be done, and most indicated that they expected to be doing more in the next year. However, efforts to implement this usually took the form of one or more specific projects, such as resource market research, working on better long-range teaming agreements, or determining future areas of materials vulnerability. In only two-three cases did the authors see evidence of a commitment to building a relatively comprehensive and proactive strategic management system in the materials function.

The situations, quotations, exhibits and concepts presented in the previous chapters were taken from isolated situations, with one or two incidents coming from one company, one or two from another, so that the picture which is presented shows several examples of what is occurring across the industry, but relatively little of the total picture occurs within any one company.

Incidence of Occurrence

Figure 100 presents the incidence of occurrence of various strategic management of resource markets functions among the organizations studied.

Column one shows the strategic management functions which were studied in interviews with managers. Columns two through five show categories of participation in these functions. The first category is "Organization doing this function." This means that the author judged the company as doing tasks which could justifiably be called "doing the function." No judgment is being made to how well or how thoroughly the function is performed. That is, if an organization was judged to be doing "environmental surveillance," there was some evidence given that the company was actually examining long range issues in its resource environment as part of its strategic management process.

The column noted "explicit recognition" refers to the fact that the management that was interviewed made explicit statement that this function would become part of the management task in the future. Included in this column are companies "doing the function," and, consequently, this is a cumulative total of actual performers and explicitly intended performers. Column four refers to "implicit recognition" which is a category used to list companies where management voiced a concern for the strategic value and importance of the function, but did not indicate any plans to implement it or did not show evidence that action would be taken.

Finally, the last column refers to organizations who provided explicit documentation of the performance of the function. Several companies indicated to the authors that they were doing the function, and discussed projects, but could not or did not provide documented evidence to confirm this. This column represents companies noted in column two who also provided documented evidence. The sample size of this analysis is 28 companies, as listed in chapter 2.

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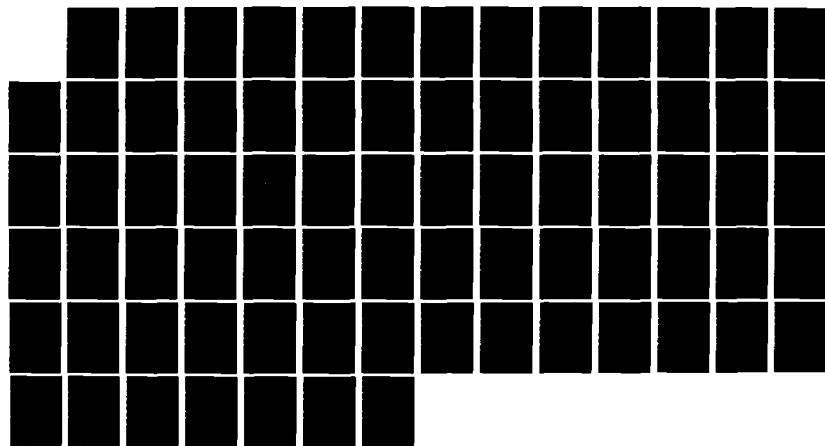
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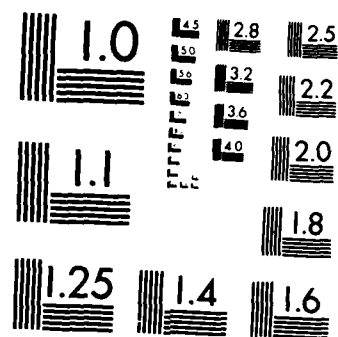
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Strategic Management Function	Total N = 28 Companies		
	Organizations Doing This Function	Organizations with Explicit Recognition	Organizations with Implicit Recognition Documented Implementation
Comprehensive System	0	2	9
Environmental Surveillance	2	3	9
Resource Market Research	2	6	11
Critical Materials Usage/Availability	5	8	14
Strategic Dependency Analysis	0	12	10
Supplier Relationships Management	3	5	8
Technology Planning with Lower Tiers	2	6	8
Providing Lower Tier Suppliers Strategic Plans ⁴		7	7
Entrepreneurial Focus	2	4	3
Manufacturing Technology for Lower Tier Suppliers	4	5	2
Production Surge Planning ⁰		3	2
Procurement Organization ¹²		15	5
			12

Figure 100: Incidence of strategic resource market management tasks among aerospace companies

Recommendations

What, if anything, can be done to improve the incidence and quality of strategic management of resource markets by DOD contractors? A few recommendations are provided.

Management Education

Having conferred with dozens of managers in the cross section of companies, the authors conclude that the main problem preventing more strategic management of the resource market function is lack of education and training of managers. This is, to a large degree, worsened by the continual short-term pressure on materials managers to meet current needs and deal with tactical problems. Many expressed high interest in doing more long range thinking, but felt their time did not permit enough of it.

To assist the defense industries in education of materials managers and others interfacing with the materials function, the report provides several normative examples of not only overall issues and processes for strategic approaches to the materials function, but also a presentation of strategic management processes in general which may be adapted to include materials issues. It is recommended that materials managers in aerospace companies study this report, examine the various figures and approaches discussed--most of which have come from the companies studied--and that they use this report as a source of expositing new ideas into their organizations. Several companies indicated a need for training, executive development, and continuing education programs aimed at strategic management for materials managers. This material can be sought through various chapters of the NAPM, and two of the managers interviewed indicated that they were participating in such programs with NAPM.

Organizational Changes

Recommendations for organizational change include the following:

- (1) Adaptation by more aerospace companies of the types of materials management staffs as shown in the Appendix on organization. This should include more use of commodity staff specialists in planning roles, and use of staff personnel in functions such as supplier manufacturing processes, long-range supplier relationships plans, dependency assessment for materials and technologies, and coproduction and offset programs.

- (2) Increased use of materials and technology strategy councils, including divisional and corporate-wide councils.
- (3) Increased participation of materials managers on strategic planning staffs, and a more major role than through the manufacturing functional plan. Materials managers should organizationally interface with program/strategic business unit managers directly, and not through the manufacturing function. Interface through manufacturing gives too much orientation toward internal production support, which is a very serious mistake with 40-60 percent of sales dollars spent in outside acquisitions.
- (4) Scheduling of quarterly and annual materials and resource market strategy reviews with broad issues being identified and specific programs being assessed and evaluated.

Materials Management Functioning

Although part of the organizational changes, the functioning of the materials management operation should have the expectation--from top company direction--of being (1) concerned with external, resource market strategic issues, and (2) expected to function in a proactive, entrepreneurial manner. The profession of procurement itself needs change toward a more sophisticated and higher visibility/role organization. Much of the job for doing this is on the shoulders of the top procurement official, and it is mainly a job of selling this strategic role in the company.

However, customers must also expect this type of functioning to occur. DOD, for example, should expect that during source review and qualification, a viable strategic management function should be in place, and contractors should be assessed for fitness prior to award on their demonstration of an on-going, proactive materials management function identifying and managing strategic resource market issues. This necessitates a high degree of functional capability in DOD to be aware of strategic resource market problems within lower tiers, and the inclusion of specialists in this area on source review teams. By effectively demanding--and funding--this effort, DOD can press for improved quality of strategic resource management.

Functional Improvements

Specifically, the following aspects of strategic management require improvement within contractors:

- (1) Use of strategic, comprehensive resource market plans.
- (2) Functional inputs of materials management to strategic plans.
- (3) Use of a system of plans for resource market management, including subplans in:
 - Resource dependency analysis
 - Critical and strategic materials usage and availability
 - Manufacturing technology in lower tiers program
 - Subcontractor relationships planning
 - Long range make or buy studies*
 - Technology subplan, produced by extended procurement organization, not just technology/engineering personnel unfamiliar with vendor strategies
- (4) Increased functional review of SBU plans for resource market support requirements in long-run.
- (5) Incentives, motivation and rewards for proactive management of resource market relationships

Policy Changes

Most important of the authors' suggestions for DOD policy change is that of what might be termed an implicit policy to accept poor or nonexistent strategic resource market planning by contractors in the selection of award recipients. It is recommended that acquisition policy include a review of the following managerial processes at contractors during the source qualification process, and that contractors judged deficient in these areas be nonqualified for bid solicitation:

- (1) A strategic planning system which encompasses the various items of content and cycles shown in this report, with

*Although the concept of make or buy usually applies only to subcontract manufacture, the same analytical planning and financial modeling should be done for technologies.

particular emphasis on environmental assessment.

- (2) An environmental assessment program which examines the resource market environment over a ten year horizon to identify specific areas of emerging and potential constraint upon the ability of the contractor to delivery prospective materials, manufacturing capabilities and technologies during the life of the proposed weapons system acquisition.*
- (3) The environmental assessment should include as close of a definitive breakdown of materials, manufacturing processes and technologies as can be defined initially in the qualification process, including an assessment of lower tier supply capabilities, competing needs for these capabilities, and projected shortfalls.
- (4) Acquisition policy should demand contractors to address shortfall, contingency and high risk resource constraints in an entrepreneurial manner, rather than as projections of time, cost extension or required engineering changes (a reactive mode). Contractors should be expected to assume risks which are approved by contracting officers from the Government in a proactive fashion. This can be done either by government agreement to stockpile, by contractor effort to stockpile, or by contractor effort to develop strengthened sourcing relationships to assure the availability of resources. Resource constraints should no longer be accepted implicitly as a condition of doing business and a norm for contractors, but as a source of poor preparation.
- (5) Although contractors should be expected to accept increased risks commensurate with a proactive stance on resources, not all risks should be borne by contractors. Risks can be minimized by effective, long-term planning, building stronger supplier relationships, standardization, and other efforts which minimize the downside (program cancellation) risk financially. However, in cases where such downside risk cannot be minimized by effective resource market relationships management, government profit terms on contracts, use of multi-year contracts or other suitable means for the government to share in the distribution of downside risk should be employed. Failure for both the government or the contractor community to now shelter resource market risks in these above ways will ensure that major weapons system acquisition efforts will not only remain vulnerable to a very uncertain resource market, but that these risks will probably increase as

*It is recognized that during preliminary source qualification prior to award of phase I contracts a weapons system is far from definitization of its configuration and materials/technologies content. However, the research in this report shows that contractors plan for technical approaches to emerging weapons systems needs long before a DSARC I occurs, and whatever the approach they are planning should be secured with environmental analysis. Furthermore, technology changes do not usually obsolete major materials and processes, such as aluminum sheet or NC machines, and where these are expected to be used, regardless of a design configuration, planning should occur for them.

resource markets become more uncertain. Such a policy of passive acceptance is not in the national interest and is a direct demise of acquisition stewardship in support of major command missions.

- (6) Not only should strategic planning systems expected of the contractors contain environmental assessment and proactive objectives and strategy plans, but they should also include specific program plans and strategies in conjunction with key lower tier suppliers. Contractors bidding for prime contract awards should not be considered qualified as sources unless they can demonstrate effective lower tier programs for the acquisition of material and technological resources, for the development of state-of-the-art or near state-of-the-art manufacturing technologies within lower tier suppliers, and programs to proactively deal with contingencies which may arise during the acquisition cycle.
- (7) The government acquisition agencies should develop personnel highly skilled in assessing strategic plans, should become an example of entrepreneurial resource market management, and should not merely delegate this to industry without doing effective work itself. Each emerging major weapons system should have a resource market plan developed as part of the acquisition management data package, including acquisition strategies for key critical material, manufacturing and technological resources. Data provided from contractor reviews can provide important information for these reports. However, care should be taken so as not to level proprietary efforts by competing contractors by indiscriminate disclosure of plans and efforts of contractors to other contractors. Access to strategic plans of contractors requires the highest in fiduciary relationships on the part of government personnel.
- (8) Although much of the above policy direction is aimed toward requiring a larger role of contractors in resource market management, the government role should also be improved. The "delegation to industry" principle is consistent with the Reagan Administration approach to problem solving, but a government program aimed at better environmental analysis of emerging and potential resource market problems should be developed and implemented. This can serve not only as a means to ensure that perceptions and conclusions of contractors with respect to resource markets is accurate, but also as a basis for proposing resource market initiatives which are better done by government policy and program than through contractors. For example, stockpiling of resources or capacities of suppliers for a cross section of major programs might better serve to reduce risks than individual contractor programs. Long-term contracts, say, for aluminum capacity might be used by several programs in case one became cancelled.

Furthermore, the government may wish to make manufacturing technology investment decisions in certain suppliers due to analysis of overall multiple program benefits and use, rather than simply in one contractor for one program. This might serve to help leverage the investment across several programs, rather than require that a single program be extended in order to amortize a manufacturing technology investment. For example, the manufacturing technology investment for the F-16 program is being amortized by large quantities of aircraft for both U.S. and foreign military sales. Not all programs have this magnitude of throughput, but might still require important technology improvements which could be amortized across several programs. For example, if, say, a manufacturing technology investment program by DOD were made at Douglas Aircraft Company, it could be used in subcontract manufacture for military transports which might include Lockheed or Boeing as a prime contractor and not merely Douglas. Such a perspective from DOD on where to improve a supplier industry would best be made by an overall resource market management program at DOD.

- (9) This research shows that the "Slay Initiatives" are very important in dealing with the industrial base problems; in particular the increased use of multi-year contracts, on a selective basis, is very important to assist contractors in making important risk investments not only internally but in supplier relationships which are necessary to improve the viability of the industrial base.
- (10) Although constitutionally, acquisition management is a "political football," with Congress reserving the right to make major spending changes on a year to year basis, short-sighted political opportunism, major changes in defense directions on what appears to be a "monthly" or "quarterly" basis, has major repercussions of uncertainty in the industrial base. It is not suggested that the role of Congress be changed as a "watchdog" of the expenditure of public funds, but review of Congressional records, comments made by contractor managers, and comments by DOD personnel indicate that the major bodies responsible for appropriations are not operating under any sort of "strategic plan." If lower tier suppliers, prime contractors, and DOD agencies operate with strategic plans, yet Congress operates with short-range, almost "impulse" style management, the entire strategic process so necessary to sound long-range defense management becomes in jeopardy. Private contractor organizations are business entities operating on business principles in the free enterprise system. They cannot be expected to jeopardize the future and profitability of their companies on patriotism. They respond to economic opportunities and risks. If Congress continues to present an environment of heavy uncertainty about support of major programs, this fact will be a major force in continued erosion of confidence on the part of the industrial base and will hinder efforts to secure U.S. resource flows in an uncertain supply market.

Summary

Concerning strategic management, many of the DOD contractors studied are operating on the fringes of management technology with respect to strategic planning. Although several have not implemented sound strategic planning processes, the defense industry as a whole is very proficient in this managerial skill. Companies lacking in strategic management skills and personnel can gain from studying this report, implementing its suggestions and normative models, and responding to the changed DOD program expecting more strategic resource market management.

Environmental assessment is particularly weak among contractors. Even those performing this function, do not include adequate assessment of emerging and potential resource market environment issues. The environmental focus is limited almost entirely to sales markets and the probabilities of certain programs being funded.

Competitive assessment is almost totally lacking in most companies, not only with respect to competitive approaches to emerging DOD needs, but also toward assessment of competitive initiatives for resources. This is a major area of strategic management deficiency among contractors, and in particular assessment of commercial competition for common defense resources is a major cause of constraints on military projects.

Strategic planning issues and challenges identified in the companies studies are almost exclusively sales market oriented. Rarely did the plans or the planning processes observed by the researchers identify resource market issues for overall corporate or divisional concern. When planning examined resource needs, it usually focused entirely on internal resources, not external resource market factors.

Business opportunity evaluation of the DOD market, the first step in planning long-range resource needs, breaks down to issues of (1) investment exposure of the firm, (2) investment intensity, and (3) cost leadership opportunities. The major driving force frustrating investment for long-range DOD needs is difficulty in perceiving the survivability of a proposed program. Where such perception is clouded, limited investments occur. However, such uncertainty is not limited strictly to DOD opportunities. In commercial programs, where markets are uncertain, there is similar

reluctance of investment. However, the example of commercial aircraft is an important dichotomy. Aircraft producers make investments in programs with breakeven several years in the future, with uncertain sales volumes merely as a requirement to survival in the industry. The reason this is done is because sales come in incrementally, and there is always a chance that enough sales will be made to breakeven if marketing efforts continue. Where DOD programs are seen as "digital" in success--that is either you win it or you lose--this type of risk of survivability tends to reduce enthusiasm for commitment to resource capabilities when there is a strong risk that not only will program volume not be sufficient to shelter risks, but the digital award may reduce the contractor's cash flow to nothing.

Nearly all companies are doing operational strategic plans, but there is very limited use of long-range strategic functional plans, particularly in areas such as procurement and technologies. There is very rare use of formal technological planning, but merely individual ad hoc technical reports being used. There is rather common use of financial plans, manufacturing plans, and facilities (internal) plans, with a few companies doing long-range manpower plans. Consequently, the system of plans concept with a matrix of strategic operating plans and functional plans integrated together is generally a rare occurrence in the aerospace industry.

Within the procurement function per se, strategic factors that are being addressed are limited to areas such as:

- (1) Perceiving trends and challenges for resources --trend projection.
- (2) Improvement of the procurement organization for better strategic management.
- (3) Use of the computer for better planning
- (4) Increases in the use of coproduction and offsets
- (5) Ad hoc make or buy studies, although most are not long-range in focus.

Very limited, nearly non-existent, effort is being made in areas such as:

- (1) Resource market environmental surveillance
- (2) Forecasting contingency scenarios with regard to resource availability and costs
- (3) Determining strategies and entrepreneurial actions to make the supply future less challenging to the contractor.

As a result nearly all DOD contractors are "reactive" in their approach to resource problems, and DOD receives the results of this managerial style in the form of delays, cost increases, and changes in materials use in weapons systems. However, most materials managers indicated that more of the strategic management should occur, many indicated specific efforts to improve their strategic management, but many also called on DOD to make major policy changes to allow better risk management with lower tier suppliers.

APPENDIX A

Business Environment Assessment

The purpose of this appendix is to present a discussion and example of business environmental assessment as conducted by some of the prime contractor organizations studied. Such an assessment is necessary as a basis for long, range strategic business planning of technological and other resource needs as well as planned programs and other marketing efforts.

Government Market Research

A small portion of the companies studied had a formally established function termed "government market research." Most firms merely had divisions termed business development, market development, environmental assessment or other general function. Those with a formal government market research person or staff focused on identifying and analyzing those issues and factors which interact to determine and influence the market potential within the DOD/Congressional program planning and funding arena.

The following is an excerpt from a discussion concerning the government market research function at the corporate headquarters of one large contractor:

Government market research resides in the corporate planning office and operates as a function of the overall corporate environmental forecast, of which the government environment is one portion. We examine the government market portion in a fair amount of detail, focusing on:

- (1) the world political/military/economic environment
- (2) DOD budgets
- (3) categories within the budgets
- (4) product categories/programs

For the sake of our company, we tend to concentrate on the aircraft, missiles, space, and ordnance categories, as well as programs in NASA and the Department of Energy.

We try to evaluate the total markets and look at what the divisions are doing and where there is a fit. The main objective is that of gaining a market concept.

We look at, for example, the requirements for aircraft-- what they have to do, the kinds of aircraft bought today, and how they are used. We try to judge what is likely to occur in terms of will the aircraft be the same types as now or will requirements

cause them to have to do something differently. We are really a combination of political scientists, military strategy and tactics analysts, technicians, and program analysts. If something will need to be done differently, what are the areas that will have to be emphasized and when can you expect that to happen? We develop some proposed and likely future military scenarios.

Most of the weapons systems we have now are designed for the NATO type environment. We do not feel that in the long run the US will continue to concentrate on a NATO type of environment, but will move more to a world environment-- what is going to be required in the other world areas for military roles versus what is required now.

We tend to see that we will need lots of firepower, like we have now, but a lot more mobile and a lot lighter. It will also need to be a lot more maintainable in our product performance objectives. We then try to translate this into where we think the emphasis will be in the future budgets. For example, aircraft we have now are relatively new and tend to last for about fifteen years. The trend is to emphasize weapons and not platforms. That is a change in the weapons mix on the airplanes with a shift in terms of modifications to go to digital avionics updates.

We are fairly pessimistic about there being a lot of new airplane programs. The opportunity will be on a lot of new missile programs, ordnance weapons, antitank, and air-surface weapons. It will be more of a derivative and modification market of the present aircraft. The aircraft we have now are capable of world environmental deployment, given different armament packages and there is enough life in them to last. Of course this is a biased perspective, since we make the aircraft. But we do not expect to develop an all-new aircraft, but to go with the maximum number of derivatives from the F-15, F-16, F-18 and so forth. A lot of this tends to be judgmental however.

On the political side of the equation, how will Congress feel and will they change their mood over a period of time? We go back and look at the amount of money that DOD requested in prior years and what Congress has done to it, and what Congress is saying and doing with the current budgets. You develop a position that the mood is changing and they are more bullish and concerned over the lack of spending for defense. If you try to balance off the "hawks" and the "anti-defense" people, you still get an increasing trend. Some want a ten percent per year real growth. But when you go out ten years, the idea of who is for or against defense spending in Congress kind of breaks down.

When we are looking out that far, we move away from the budgetary politics of the appropriation cycle, and look more at military questions around the world. What will the US force structure be like in 1990? We try to examine the number of carriers and it is increasing and decreasing very slowly. The same thing with the number of divisions. The number of divisions we plan on for 1990 is the collective judgment of people, Congress and the President.

Ten to twelve years ago, we said three and a half million men was too much, and sixteen carriers is too much. So we forecasted a decline after Vietnam. We were a little bit low on almost everything but the number of divisions. But we are spending less per element of the force structure, and this we foresaw. Equipment is simply more expensive and we are not spending so many dollars on support. A lot was bled out of the force structure. When you look way out, you do not look at Congress, you look at "what is the threat?" Now the issue is the Red Army in Europe. What will it be in 1990? That is what we are looking at in our forecast.

There are contingent decisions. A, you keep the force structure in Europe, or B, you deploy a token force in the Middle East, or C, what else? We try to figure where the planning and the budget will go. We are not sure the US will have European alliances on military affairs in ten years from now. Look at the changing alignments of the past few decades. It was Russia/China versus US/Europe in the 1950s. Now it is US/Europe versus Russia, US/China versus Russia, and even Japan is in it, but with low spending. Who are your fickle partners? The French and Germans have openly discussed going it on their own.

The other scenario we have to look at is the "Fortress America" one. We look at the North/South thing to see how big a basis of conflict there will be, but it is hard to see a military dimension to that problem. There is a potential for military force, but it is hard to see how to calculate a sizeable force or how to use it.

In our short term planning, the next one to three years, on the XYZ program, it will be (1) will the President ask for it, and (2) will Congress put the dollars in the budget? This is what we look at.

We do our estimates independent of DOD people and their projections. We have found that DOD is a poor source of accurate information. If we had relied on DOD sources in 1968, we would have forecast an armed forces drop to 3.1 million and procurement diverted from ammunition to modernization. DOD people are merely given planning assumptions once a year and they run them out.

The problem with DOD planning, as we see it, is that they are concerned about this year's Congressional appropriation, not much in the long term planning. If they were more strategic and long term planning oriented, this whole thing would be a lot simpler, we would waste less taxpayers' money, and the industrial base would be in better shape. Beyond a year, DOD planning doesn't mean anything to us. It is just a run on existing programs.

But DOD has started to do some long range planning, for about three years now, and they are still trying to get their feet on the ground. There has been some success in starting to think about these things, but we can't realistically say they do long range planning as yet.

We try to mix in as many external sources as we can get in our planning--economists, Brookings, think tanks, and so forth. We are trying to get the "need scenarios," and try to assign some probability that military persons will see and champion some scenarios and get an OR written. We don't get into specific programs too much. The divisions do that, not us. The decentralized engineering and program control identifies and selects programs from our scenarios upon which to allocate resources. They select the milestones for the next weapons systems and identify a basis for them, plus try to prove them as a reasonable scenario.

We have to take technologies and R&D efforts and try to have technologies grow in such a way that when you get to an identifiable product, we have done the necessary homework that we can incorporate all the latest up to date advances. We use our own funds, but try to supplement it with contracted money. If we don't get contracted money from the government, we have to decide "Is it critical enough to spend our own money on it to be competitive?"

Now as you can see, this is all focused forward at the usage and market environment--our customers. It does not look backward at the assessment of the supply environment as you asked earlier. In many cases that I can point to, the general manager has gotten into trouble because of the supply environment. As often as not it is that environment that is the real problem, and most of our general managers are very sensitive to the supply environment that is taking place and how it might come back to haunt them.

However, as you can see the process is somewhat skewed toward the customer environment.

In another company, the corporate planning people commented as follows concerning the supply environment issue in planning:

In our aerospace group, they live with the supply world and it is one of the most heavily oriented groups toward the supply environment in the company. We have about 25,000 suppliers and many advanced programs. Assessing the capability of the supply environment is a key factor. It should be done before you think about bidding.

The key issue in our government and aerospace market is that resource planning is a team program. We approach market opportunities as a team, and must have the supplier tiers. In other areas, some of our commercial products, we are less supply sensitive and have our own supply channels. We are much more outside dependent in the aerospace end.

In our company, all managers must identify the most strategic issues to them over the next five years. In the past year or so, about one or two out of ten issues so identified pertain to supply markets. Supply support is not taken for granted, but is a separate strategic issue.

Financing Long Range Plans

Another major issue in business environmental assessment was that of financing the long range plans and development called for in the assessment and the business plan. The following reflects insights gained from one manager:

The allowable IR&D and B&P monies are much below the needs. The remainder comes out of earnings, subject to the approval of corporate personnel. We are very fiscally oriented in this company, and we start with fiscal responsibility and then tailor business pursuits to be compatible.

Our president holds a strategic issues retreat each year. He requests people, mainly the general managers, to submit strategic issues before the meeting. He requests papers on subjects to be at the meeting. The five year plan is not based on winning any particular programs, such as A, B, or C, so the issues are not merely program oriented. We then look at what we will do to pursue these issues and where the finances will be allocated both in pursuit of issues and in pursuit of business opportunities.

This process became more formalized two years ago when we formally chartered management to have more visibility and use of strategic planning. However, in so doing, we have decided against getting too far away from our traditional products. We would rather take more market risk than product risk.

So as an opportunity comes up, like "should we get into anti-tank missiles," we have to assess this market that is totally dominated by companies A and B. What kind of gigantic resources are required to become a member of that club? We use a computer model of cash flow and the financial aspects of getting into that business. It also assesses the risks inherent in the market.

Aerospace Business Environmental Assessment

This next section describes and provides examples of business environmental assessment as done by a few major aerospace organizations within the prime contractor companies. It has been disguised at the request of the participating companies.

Such reports describe the external environment in which the company will do business for the next ten years. Publication of the assessment report often initiates the planning cycle for the current year and establishes a common set of assumptions for long range planning studies to be developed within the companies.

The environmental forecast presents, as a basis for primary plans, a most probable view of the future-- a surprise free environment. It is recognized, however, that the only certainty about the projected environment is that it will not occur exactly as projected. Divisional organizations are, consequently, encouraged to consider as a basis for contingency planning alternative scenarios involving, among other variables, different levels of tension in the international scene and different levels of growth in the US and world economies.

Prior Year Review

A typical first section of such an assessment report is a review of the immediate prior year. The following is an excerpt of some of the kinds of information in such a review for the year 1979.

The year 1979 signified the end of an era. Detente--if it ever existed--died. The year 1980 opened with US-Russian relations closer to the level of the 1950s than to the 1970s. Concurrent with this escalation of the East-West rivalry, the long smoldering North-South conflict suddenly reached its flashpoint. Thus the world political scene is complicated and confused by the overlapping of these two separate and distinct axes of international tension.

With this theme backdrop, the review went on to discuss specific steps of conflict, such as Russian use of Cuban troops in support of Third World regimes, Soviet insistence upon Salt II terms which a substantial body of Americans regard as institutionalizing Soviet superiority, and the Tehran problem. The theme was a deterioration of the stability and international political situation. It projected these as "bitter facts that have produced somber and distrustful outlook(s) for the future."

The following presents an example of the table of contents of an environmental assessment:

I. The World: 1980-1990

- A. Transnational Trends
- B. The International System
- C. Relations Among Nations
- D. The World Economy

II. The United States 1980-1990

- A. The US Human Environment
- B. US Foreign Policy
- C. National Security Policy
- D. The US Economy

III. Business Environment

- A. Business Trends
- B. Commercial Market
- C. Government/Aerospace Market
- D. Total Aerospace Market

IV. Surprises

Graphs presented in the report included general US economic growth and inflation through 1990, as well as 1990 trends in DOD budget alternatives, world passenger air traffic, DOD aircraft market, DOD missile market, and commercial jet airliner deliveries.

The section on transnational trends examined food and population crises, resource shortages, pollution, development of materials-saving technologies, technological innovation with social and political consequences, communications, changing personal values, terrorism, and the decline of democratic institutions as factors influencing the shape and trend of the sales markets.

The international system section examined "interdependence of nations coming of age," continued fragmentation of the nation-state system through devolution, growing roles for international organizations, and the relative power of the principal actors on the international scene.

Relations among nations focused on the probability of general war. Because of the specific military implications herein, this section will be quoted in excerpts:

Today we are no longer comfortable with the forecast that general war is unlikely. Events of the last year have substantially increased the general awareness that a World War could and possibly will occur. These events include:

- (1) European rejection of the enhanced radiation bomb. This increases the probability of success by Soviet conventional forces.
- (2) Statement by Henry Kissinger that the US would not repel a European invasion by the USSR by nuclear force because of the threat of escalation.
- (3) Publication of a best selling fiction book on a plausible start of World War III.
- (4) The Afghanistan invasion.

This company's orientation toward the international military/political market was strongly biased away from strategic weapons toward conventional and tactical weapons, the products it largely supplies. For example, it examined nuclear weapons as being in a "balance of terror," and, consequently, does not examine DOD expenditure options leaning more heavily toward strategic missiles, manned bomber or other weapons beyond the company's traditional markets. One of the dangers in such an environmental assessment is that they become self serving and are aimed at selling internally and to suppliers the product plans of the company.

The remainder of the introductory section gave a geopolitical analysis of international relations and the negative interpretation toward the need for more and more sophisticated weapons of a tactical nature. With respect to NATO, three courses were presented:

- Course 1: US and European nations maintain present posture in Europe
- Course 2: European nations take larger share of defense of Europe
US redeploys its forces.
- Course 3: European nations drift into neutralist position and US
withdraws overseas forces.

The analysis examined Russian internal problems, the Middle East, and Africa, as well as military potentials in the Far East and the Pacific Basin.

Looking at the US, the analysis examined internal economic and domestic problems and their impact on defense. It examined, for example, the impact of changes in the quality of education upon the military force in the 1990s. It looked at national security policy, major force deployment scenarios, and the expanded role of military forces. The threat was seen largely as Russian oriented. The basic assumption for strategic balance was "equivalence" rather than superiority as the prevailing strategy for the US. In determining the revenue and affordability base for predictions in military spending, the report examined the US economy and its growth.

One important section pertaining to the subject of this report was the impact of bottlenecks on defense production. The report stated:

A surge of commercial aircraft sales has put the aerospace industry at a high point and critical shortages have appeared in the supplies of specialized metals and parts. Relief from the current round of shortages is likely to occur in the next year or two, the result of declining sales of commercial aircraft and increasing capacity of many aerospace suppliers. Another round of shortages is implied by the contingency forecast in which the US reacts to Soviet aggression by means of a buildup in military manpower and additional procurement of weapons. This situation would put the aerospace manufacturers once more in competition with one another for vital materials and the aerospace manufacturers, as a whole, in competition with the producers of ships and tanks. The likely choke-points would be, as they are today, related more to the capacity of US manufacturers than to the scarcity of imported minerals. If this contingency arises and it becomes necessary for the government to divert critical materials to military production, commercial aircraft manufacturing will suffer.

The reports section on commercial products was much more definitive in its data base and analysis than the section on military. Military market forecasting was largely a geopolitical analysis coupled with seemingly arbitrary defense budget projections. Commercial forecasts involved much more micro-data and specifically identified demand issue determinants.

The following section was extracted from the report's section on the government aerospace market, and is representative of the type of issues and approach used in market analysis.

Government Aerospace Market

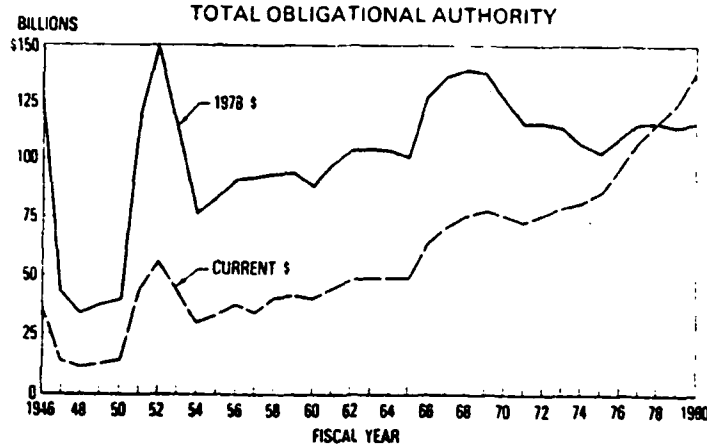
Defense Budget Increases in Real Value

As the decade of the eighties begins, the defense budget is buffeted by conflicting forces. The public debate in 1979 on SALT II highlighted the growing disparity in conventional military forces of the United States and the Soviet Union. The Soviet invasion of Afghanistan greatly accelerated the changing public perception of the imbalance between the two countries and demonstrated the willingness of the Soviets to use military power when it serves their interests. The need to respond to the increased Soviet threat creates pressures for substantial increases in the real value of the defense budget. On the other hand, demands that high U.S. inflation be curbed by lowering federal spending places restraints on defense as well as social programs. As a base case forecast, the defense budget is expected to increase moderately in real value with little change in the existing force structure. The result is a budget insufficient to satisfy the desires of those advocating a strong response to the Soviet threat but excessive in the view of those favoring increased programs for social betterment.

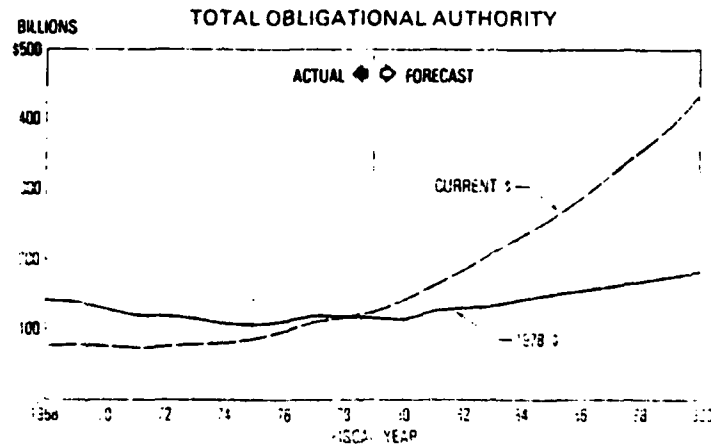
Department of Defense budgets have been characterized by distinct patterns. To simplify measurement of the relative impact over periods of time, the gross national product deflator has been used to convert current prices into constant prices. The large, sudden increases resulting from World War II were quickly eliminated as military capability was dismantled after the war. Korean involvement required another surge. However, the end of fighting did not result in a return to pre-war levels as emphasis shifted to maintaining active forces at relatively high levels. After another buildup for Vietnam, spending was allowed to subside again. The post Vietnam era has been characterized by introduction of the volunteer force and a substantial decline in military personnel. Since 1975 efforts to increase defense spending have produced mixed results. The intent to increase the real value of defense have been negated to some degree by inflation higher than anticipated. However, in recent years the need for higher defense budgets generally has been accepted by the public.

Our basic forecast follows the trends established in the 1981 budget submission by the President. In the near term our forecast is slightly higher, anticipating that Congress likely will add to the

LONG TERM DOD BUDGET TRENDS



DOD BUDGET FORECAST

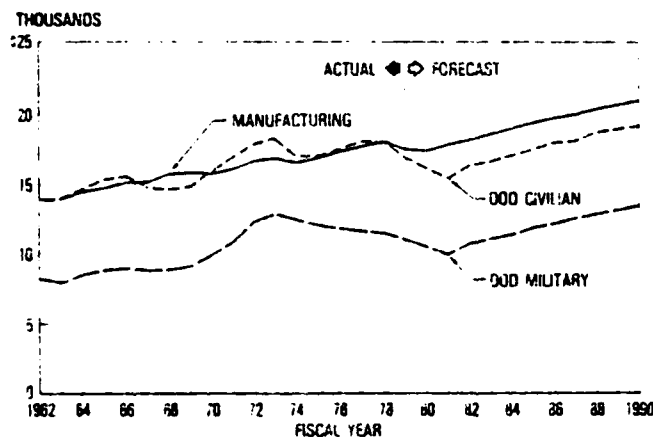


President's request. In the longer term, the real growth rates forecast by the administration are continued. The result is a budget which increases in real value at an annual rate of 4.6 percent between 1980 and 1990. This real growth in the overall

budget, with essentially constant manpower levels, means the hardware accounts (procurement plus research and development) will increase 6.6 percent annually.

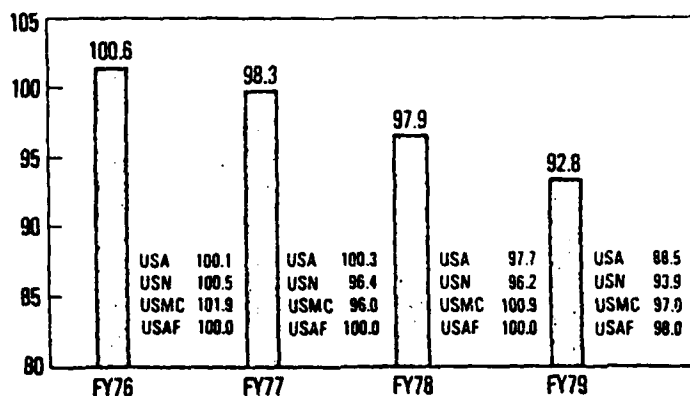
Just prior to Vietnam, military personnel strength was 2.7 million. As the war escalated it was increased over a four year period by about 30 percent to 3.5 million. Since 1969 military strength has been allowed to decline to the current 2.0 million. Now manpower is becoming a crucial factor in defense planning. With the advent of the volunteer force, military pay was increased to attract enlistments but since 1973 the military per capita pay has been eroding. Expressed in 1978 dollars it has fallen from \$12,800 in 1973 to a current level of \$10,000, a decline in excess of 20 percent. Average manufacturing compensation in the civilian sector during this period has increased about five percent in real value. Thus the current military pay levels make it difficult both to attract volunteers and to retain personnel with critical skills. The severity of this problem is reflected in the charts from the FY 1981 Posture Statement by the Joint Chiefs of Staff showing declines in both enlistments and career reenlistments.

PER CAPITA COMPENSATION - 1978\$



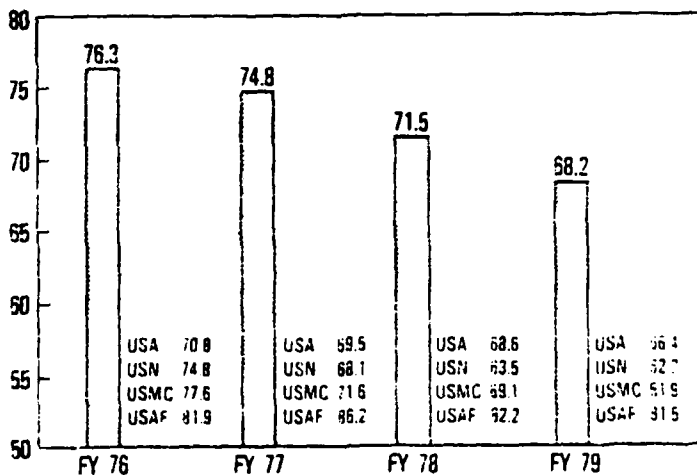
DOD RECRUITING

(% OF OBJECTIVE ACHIEVED)



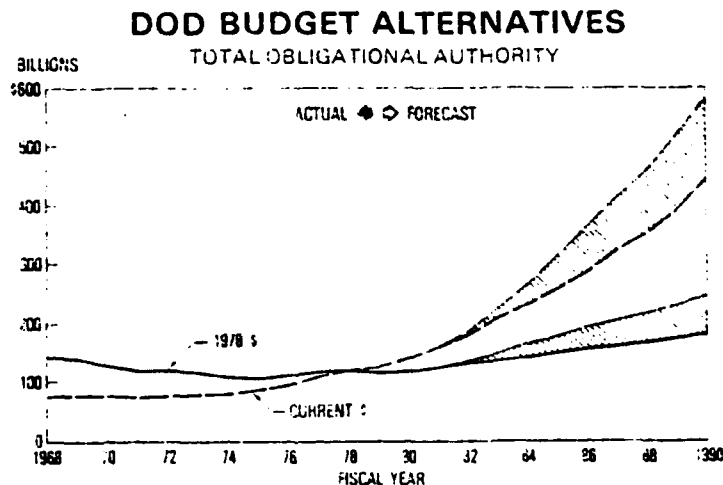
DOD CAREER REENLISTMENT

(% OF ELIGIBLES)



There is an ongoing debate whether to reinstitute registration and eventually the draft. With or without a draft, it will be necessary to increase military pay both to attract personnel and to retain those with critical skills. Our forecast of the defense budget is predicted upon restoration of the lost purchasing power to military personnel. Thus pay will need to increase faster than inflation. As shown in the chart of per capita pay, a gradual, rather than abrupt, restoration is anticipated.

Our defense budget forecast shows a smoothly rising trend line. But, as depicted in the historical portion of the chart, budgets don't move in smooth patterns. Unpredictable events will cause the trend to move erratically either above or below that shown; we cannot predict when these perturbations will occur. It is clear that if the United States military force structure is to engage hostile forces in the Middle East and simultaneously maintain the current commitment to NATO, the strength of the armed forces must be increased. The reinstitution of the draft as a means of increasing military personnel, therefore, is one such external event that could impact the defense budget. To evaluate this impact we assumed that military personnel would be increased 50 percent over a five year period. Concurrently, DoD civilian personnel would increase 20 percent and the higher

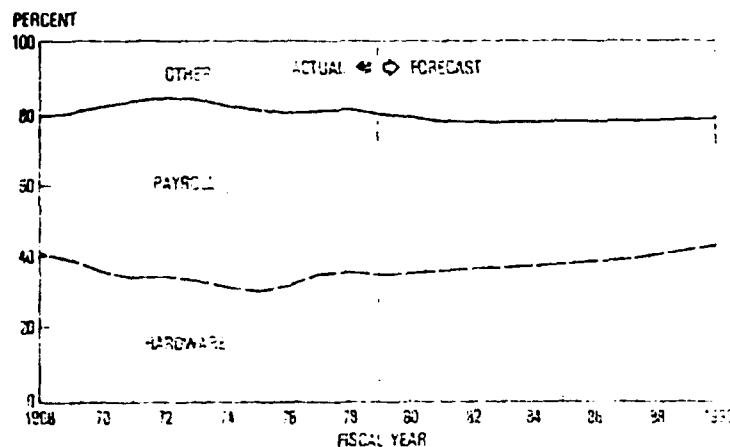


manpower levels would require hardware accounts increasing 10 percent annually in real value. The result of this assumption is a defense budget increasing, in 1976 prices from \$116 billion in 1980 to \$245 billion in 1990, an annual growth in real value of 7.7 percent. In current prices the increase would be from the \$139 billion of 1980 to \$533 billion in 1990. Such an increase will require that defense absorb almost nine percent of the gross national product, considerably higher than the current five percent and about the level that prevailed prior to Vietnam.

Hardware — A Major Factor in Real Growth

The change in national security policy which we have described will have a major impact on the development and procurement of defense hardware. As the defense budget declined and personnel costs increased with the transition to the volunteer force, reductions generally came from hardware accounts. The share of the DoD budget devoted to hardware declined from 41 to 30 percent between 1968 and 1975. Now that personnel levels have stabilized and the budget is increasing in real value, the research, development, and procurement accounts are increas-

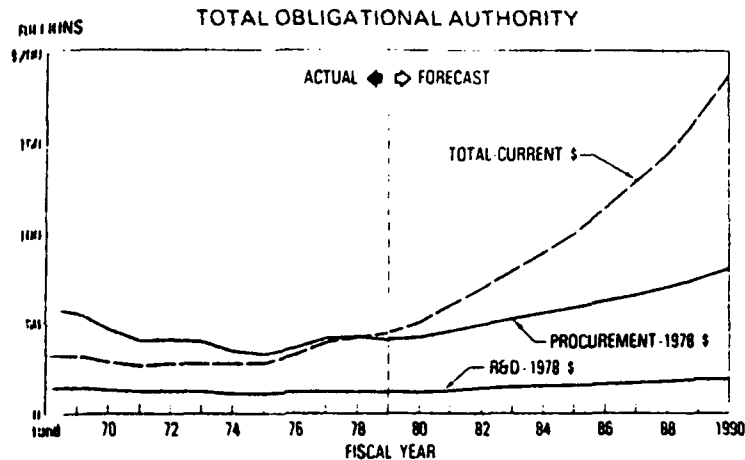
DOD BUDGET DISTRIBUTION



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DEFENSE HARDWARE FORECAST



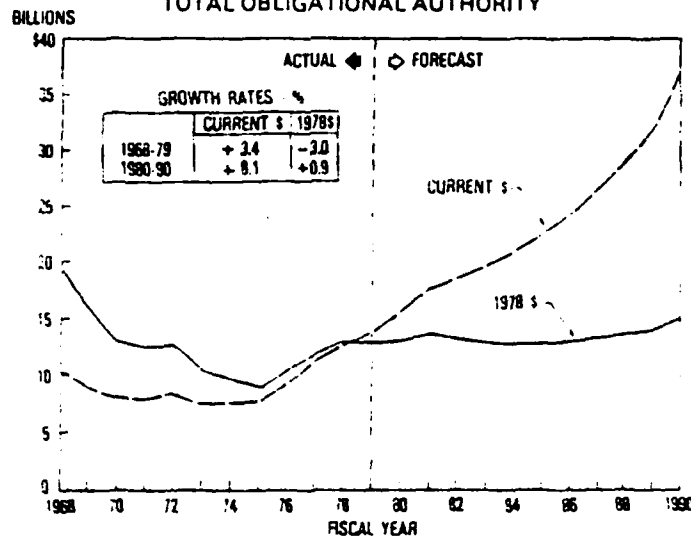
ing faster than the overall budget. This reflects a military force that is becoming more capital intensive. There are several issues associated with the expected increase in hardware procurement. All major defense programs are supported by their own constituencies who are demanding a share of the increased budget. The problem facing the government is to allocate increases to the programs making the greatest contribution to immediate needs. For example, after the Russian invasion of Afghanistan there was a demand that the B-1 strategic aircraft program be reinstituted. This program may prove necessary, but it should be justified on its contribution to strategic forces, not because of a need to upgrade conventional forces. One of the major shortcomings in the current defense posture is the lack of sufficient strength to protect the Middle East and concurrently maintain a capability in NATO. Correcting this situation translates to a need for conventional weapons, vehicles, and ordnance as well as a vastly improved sea and air lift capability. It will be necessary to accomplish this conventional force improvement in parallel with efforts already underway to upgrade strategic forces. A third priority effort arises from the need to provide the necessary parts and support to insure existing equipment operates more efficiently. In addition to establishing priorities within the budget

for the acquisition of specific defense hardware, there are questions involving lead times, industry capacity, and the availability of both material and manpower to produce the equipment at the rates desired. A decision to increase force levels will result in even higher levels of procurement for defense hardware.

DoD Aircraft Market — Large, Stable, With Potential Growth

The DoD aircraft market is undergoing a period of transition. The modernization program that produced the F-15, F-14, A-10, F-16, and F-18 is well underway. Unless there is a decision to increase overall force levels to accomplish an expanded defense role, the aircraft market should be relatively stable in real value until the next generation of fighter aircraft emerge for the 1990's. Currently there are no plans to increase major aircraft force levels above the 26 Air Force tactical fighter wings or 12 Navy carriers. There is discussion of the high/low force mix within the current structure. A change in this mix could have a major impact on the individual programs involved; however, the impact on the total market would not be as significant as a change in the overall force level.

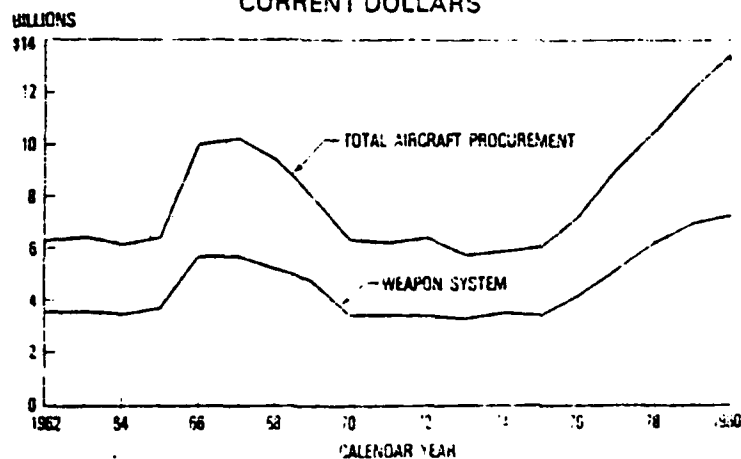
DOD AIRCRAFT MARKET TOTAL OBLIGATIONAL AUTHORITY



It is expected that there will be a shift within the procurement portion of the aircraft market. For the last several years procurement of spare parts, modification programs, and support equipment have been absorbing an increasing share of the procurement budget. With efforts underway to improve readiness, stretch the C-141, re-wing the C-5, modify the F-111 to an electronic warfare configuration, re-engine the KC-135, and equip the B-52 as a cruise missile carrier, the modification market will increase. The military aircraft market breaks down into two major components: First is the basic aircraft itself; second is the ancillary equipment market, comprised of modification, spare parts, and support equipment. The size of the ancillary equipment market is generally not well understood. A comparison of the two parts of the aircraft procurement budget over a relative long period, 1962 through 1980, reveals the ancillary equipment share to be about 43 percent of the total or almost equal to the value of basic aircraft. With basic aircraft expected to operate for relatively long periods of time, there will continue to be major opportunities for introducing new technology equipment into existing aircraft.

WEAPON SYSTEM SHARE OF AIRCRAFT PROCUREMENT

CURRENT DOLLARS



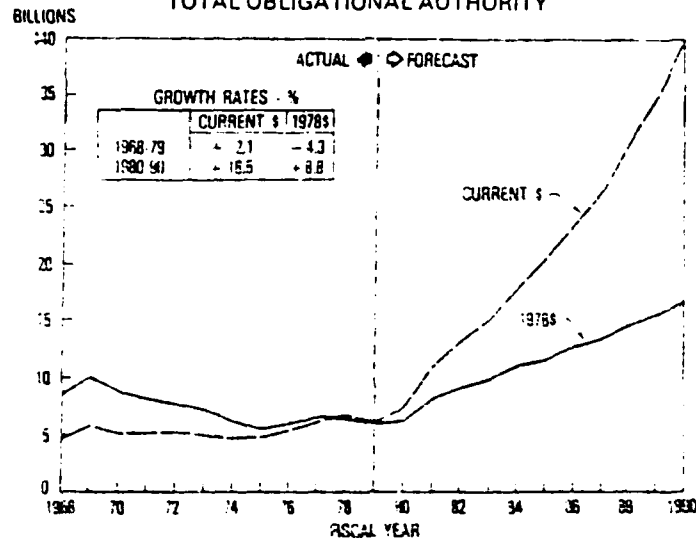
DoD Missile Market — The Growth Market in Defense

The combination of improving both the strategic and the tactical forces in parallel makes missiles the fastest growing major segment in the defense market. With or without a strategic arms limitation treaty, the outlook is for major increases in strategic forces. Questions remain about the basing mode of the MX missile, but regardless of the method selected, this program will require heavy funding throughout the forecast period. The continued procurement of the submarine launched Trident I, the possibility of an advanced Trident late in the period, and the introduction of the air launched cruise missile all combine for major increases in strategic missile funding.

In addition, the continued procurement of several new tactical missiles such as Patriot, Roland, Stinger, the general support rocket system, Pershing II, the ground launched cruise missile, and new generations of tactical missiles developed around precision guidance technologies are expected. Continuing emphasis on new technologies will be required to offset a numerical force advantage of the Soviets.

DOD MISSILE MARKET

TOTAL OBLIGATIONAL AUTHORITY

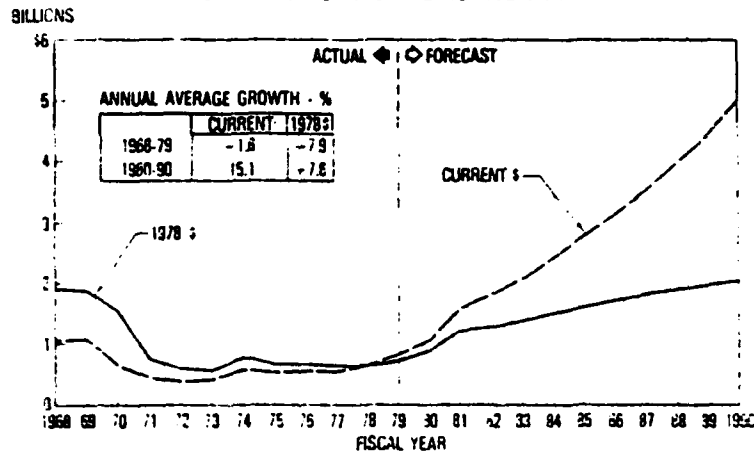


DoD Space Market

Both the United States and Russia are growing increasingly dependent on space-based systems for vital military functions. The primary defense emphasis in space continues on communications, warning, navigation, and weather satellites. The Department of Defense will have a major role in the Space Shuttle and eventually will shift from ground launch to space launch of defense satellites. The buildup for the shuttle and for development of anti-satellite capabilities result in a sharp increase in defense space system funding. Actual deployment of anti-satellite systems may depend upon negotiations with the Soviets on the use of weapons in space, but at this point development seems probable, since the Soviets are actively testing an anti-satellite weapon. Without some type of treaty banning offensive weapons in space, a major escalation of the arms race will occur as development of such futuristic weapons as lasers and particle beams progresses.

DOD SPACE MARKET

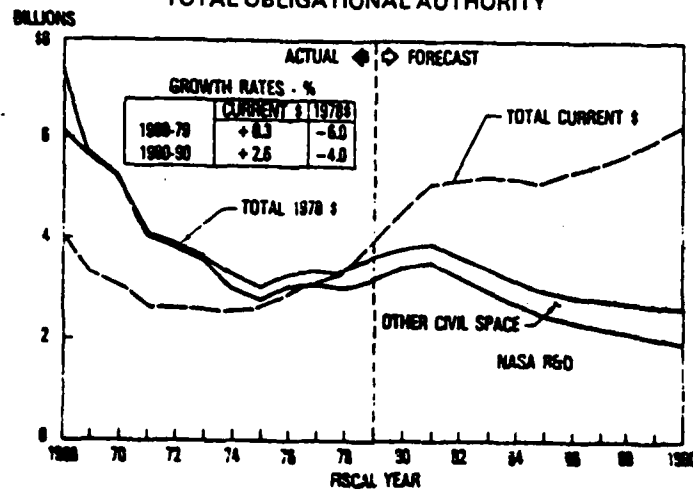
TOTAL OBLIGATIONAL AUTHORITY



Civil Space Market — Decline in Real Value

The civil space market is forecast to decline in constant dollars. The Space Shuttle, once operational, will aid in expanding commercial space applications, but this expansion will not be sufficient to arrest the decline in NASA research and development. The absence of a major goal associated with a national space program will make it difficult for NASA to sustain momentum. The need for concentrated efforts in energy related areas will detract further from NASA programs where tangible results are not evident to the public.

CIVIL SPACE MARKET TOTAL OBLIGATIONAL AUTHORITY



Appendix B
BUSINESS OPPORTUNITY SITUATIONAL AUDITS

The purpose of this appendix is to present a procedure for auditing business opportunities, including potential DOD programs, used by one of the contractors studied in this report. These situation audits are done as a part of the strategic planning process and are aimed at determining which new business opportunities/programs will be followed by the contractor. The data from the audits provide a major input to the preparation of the Strategic Long Range Plan and also serve for material in marketing reviews and the corporate review of new business plans.

Initial situation audits are prepared by cognizant managers in particular organizations wherein the opportunity best fits. The procedure used in these audits was presented to the authors in outline form and it will be presented in this appendix in this same form.

Business Opportunity Situation Audits

Program/Opportunity Name

Name as reflected in the customer planning and documentation, including appropriate program element (PE) numbers, FYDP designators or other descriptors.

Program/Opportunity Description

Describe the mission/purpose of the program from the customer point of view, the problem solved or the benefits provided. Briefly discuss how the system or product associated with this program/opportunity will function in its primary application. Identify those capabilities or attributes of the product most critical to successful performance and/or customer acceptance (e.g. accuracy, cost, etc.)

Acquisition Plans

Describe customer acquisition plans and schedule for this program.

Identify each major program phase in the customer acquisition including transition to operational utilization of the system. Program phase nomenclature should be consistent with the utilized Government major system acquisition or should be case in analogous terms for non-government procurements.

Reflect key decision milestones and other major events in program master schedules, such as DSARC milestones, IOC/FOC, etc. Document customer acquisition plans and schedules in the form in company policy. Briefly discuss any peculiarities or anomalies in customer acquisition plans in terms of viability (e.g. sole source awards, directed procurements, A-109 deviations/exceptions, etc.) Provide estimates of customer total life cycle funding for this program/opportunity by program phase. Incorporate these data in the company form policy. Note the sources and authority for funding, such as FYDP, congressional testimony, etc.

Timing Considerations and Uncertainties

In company business planning, the timing of an opportunity represents a most important and critical consideration. Given an accurate assessment of when major procurement events will occur, the problem of identifying and allocating scarce company resources is greatly simplified. Even for widely-perceived-high-priority programs, however, the timing of the "real" acquisition tends to exhibit considerable uncertainty.

Identify and discuss those factors that could cause procurement plans for this program/opportunity to be deferred or accelerated. Assess the timing uncertainties associated with this procurement in terms of the likelihood of a slip or advance and the probable magnitude of the slip/advance in months or years.

Customer Data

Identify the procuring agency, customer program manager for this procurement along with key members of his immediate staff. Note to whom the customer program manager reports in his organization. Identify and briefly comment on those attributes and characteristics this particular

customer expects or demands in the organizations which solicit business from him. Note attitudes and preferences as to the type and quality of briefing material and reports needed.

Assessment of Business Objective

Describe by program phase as appropriate the role proposed for the company in this program/opportunity (e.g. system prime contractor; systems engineering contractor; associate contractor; subsystem, etc). Describe by program phase as appropriate, the activities and responsibilities of the company in the program (e.g. technology study-composite materials, hardware design and development, logistic support, etc.). Describe the responsibilities and activities in this program that the company will and may assign to subcontractors or team mates.

Describe customer roles and responsibilities in this program opportunity (e.g. use of advocacy teams, use of consultants, foreign participation, etc.). Describe special customer activities and if a fall-back opportunity may be available after unsuccessful pursuit of primary business interests.

Program Survivability

This section addresses the long-term viability or basic worth of the program/opportunity (i.e., will the program survive such that the company business objectives can be accomplished and the question of timing). Provide estimates of program survival or a probability distribution of survival to all company business interests. Survival rationale used in this assessment shall be the following: (1) validity of need/requirements, (2) competing products/solutions, (3) funding/affordability, (4) technical and development factors, (5) institutional and procurement factors, (6) constituencies, and (7) other factors. In preparing this section of the audit, discuss the validity and urgency of the need for the system, providing the title, data, approval date and approving authority for the MENS, and if available, attach the MENS as an appendix.

Assess the competing requirements or alternative ways of solving the customer problems or providing the desired benefits (e.g. reusable items, different forms of deployment, different types of systems under the A-109 approach). Survivability addresses both initial stages of acquisition as well as competition survivability under A-109. Identify any foreign competitors to the program.

Provide an assessment of the funding acceptability and overall affordability of the program. Affordability addresses the issue of whether life cycle funding requirements are compatible with customer budgetary constraints or expectations, given an inherent competition for such resources.

Identify those technical and performance goals and/or development risk areas that could precipitate program cancellation or realignment if not successfully achieved or resolved (e.g., system accuracy, reliability, leakage, probability of kill, etc.). Identify procurement policies or considerations reflected in the customer's acquisition plans previously defined that could jeopardize the survivability of the program (e.g., lack of compliance with A-109; lack of consideration of specific issues, etc.). Note any institutional or organizational factors peculiar to the customer that could jeopardize the survivability of the program (e.g., proposed space programs that depend on the accuracy of Shuttle budget projections; over fractionation of mission area budgets resulting in reduced productivity in all endeavors; interservice conflicts and rivalry such as many DOD communications programs have).

Constituencies are defined to include both "pro" and "con" advocacy groups with respect to this program or opportunity. Identify within the procuring agency of the customer the existence of opposing constituencies (e.g., opponents and proponents of a system within, say, the Navy). Identify within the overall customer organization the existence of constituencies and their relationship to the acquisition plan decision process. Identify constituencies in external agencies that could influence program acquisition decisions, the OMB position on the program--if it has sufficient visibility--and address specifically the congressional position toward this program focusing on the districts to benefit.

Finally, other factors influencing survivability must be addressed, such as compatibility with current or prospective treaties, trade or defense agreements, or the prospects of an export license.

Identify customer documentation reviewed to assure compatibility of this program and any regulations reviewed for pertinent data and comments. Note whether GAO has conducted a study with respect to or which could impact the program. If GAO has conducted a study, briefly summarize the findings. Assess the budgetary category. DOD and other government agencies and many major corporations develop and maintain listings of programs in order of resource allocation priority (e.g., DOD recently has used "bands" or "rings" of programs to assist in prioritization; DOD also has aligned programs and program options with "basic" or "enhanced" budgetary positions to facilitate resource allocations. Identify the budgetary priority of the proposed program in terms of customer resource allocations.

Competitive Assessment

Assess our company posture in terms of strengths and weaknesses relative to competition. Identify and describe the actions that must be taken to maintain strengths through the competitive phase of the program, and any weaknesses or deficiencies with respect to the program. Include real capabilities as well as image and reputation with the customer. Describe the actions that could be taken to overcome shortfalls, and identify the preferred approach to strengthen our competitive position and posture, such as acquiring a teaming partner, hiring specific experts, use of IRAD money, etc.

Identify the direct competition (single companies and teams) for this program, and include the plant/location responsible for this effort and the assigned program management. Identify competitors that could enter the picture later in the acquisition cycle with improvement proposals or with technology exploitation efforts.

Address the competitive posture, including technical position/capability, cost position/potential, and other important issues which provide specific data to improve our competitive position, such as relevant experience,

overall image/capability in a product area, customer rapport, and congressional support/relations. Evaluate each competitor against these criteria.

Company Marketing Strategy

Provide a statement of company marketing strategy and assumptions for the program/opportunity encompassing company business objectives through all program phases. Incorporate a decision-tree/logic diagram/event network to relate customer events/decisions to company actions and options. Describe company business plans for this program, providing the relationship to customer events/activities (e.g., RFP release dates, etc.).

Describe the IRAD program directly supporting this program, noting the objectives for the year. Include titles and numbers for each IRAD program/line item. Identify technology CRAD opportunities and objectives directly related to this program/opportunity (competitive and sole source opportunities). Provide an estimate of the probability or probability distribution of the company winning all competitions enroute to achievement of the primary business objectives for this program. Include the rationale for the estimates of company success.

Financial Characteristics/Commitments

Provide the financial data needed for the program by program phase utilizing the appropriate company form, including foreign sales opportunities. Identify the ongoing CRAD or contractual commitments associated with this program. Identify prior new business fund investment dedicated to this program, or if not separable, to the product area, including visibility as to the split between IRAD and B&P funds.

Identify prior capital facility investment dedicated to this program or if not separable to the product area. Identify the prior "other" investment, such as profit dollars dedicated to this program. Identify by program phase the IRAD and B&P required for the following applications: (a) pre-proposal; (b) proposal preparation; (c) holding periods between proposal submittal and contract award; and (d) contract direct support for both current and future commitments (including cofunding).

Identify the quantities of prime mission equipment, support equipment, and spares reflected in the sales/funding data for each phase. Note learning curve assumptions reflected in these data. Identify design-to-cost goals/requirements as appropriate, including sources and authority for these data. Provide by program the fee or profit associated with the sales. Include by program phase the company value added in engineering (make). It is useful for longer-term planning to further decompose engineering value added into systems engineering and other areas of engineering effort, if possible. Provide by program phase company value added component of sales in manufacturing and production. If available, provide the fraction of company manufacturing value added devoted to materials and purchase parts (emphasis added). If available, provide cost data for recurring and non-recurring production engineering. If available, provide cost data for tooling and special manufacturing test/checkout equipment.

It is useful for longer-term planning to further decompose company manufacturing value added into shop (general), shop (precision machining), electronic fabrication, and assembly and checkout value added. Identify by program phase the inflation model or factors reflected in the sales data. Constant dollar figures are acceptable in sales projections.

Preliminary Resource Impact Assessment

It is the intention of this section to address the implications of programs on company resources, including direct and indirect cost factors. Where practical and possible, quantitative data are desired; however, each item listed below should at least be evaluated in quantitative terms. "None" or "no impact" as an acceptable response. For "high" or "great" impact assessments, provide some explanation of why the significant impact.

A. Management (general)--Indirect

B. Program Management

--Direct and Indirect

C. PD&M-- Indirect

D. Engineering--Direct and Indirect

Systems Engineering

Design Agencies/Technologies

Laboratories

Logistics

E. Operations --direct and indirect

Procurement **

Production engineering

Manufacturing/Technologies

F. Fiscal --direct and indirect

G. Facilities

Engineering

Manufacturing

Test

J. Special/Critical Subcontractor Requirements**

Management Decision Schedule

Provide a schedule of the decisions with respect to this program that management must make or may have to make this year (e.g., transfer of new business funds from reserve to the program manager's budget; level of cofunding for a system study). Note the month or quarter in which the decision must be addressed.

Provide a schedule of the decisions with respect to this program that management must make or may have to make in the years to come. Identify the year and if possible the quarter of the required/desired decision action.

Forms for Opportunity Situation Audit

The following forms/format were contained in the contractor procedures for opportunity situation audits.

BUSINESS OPPORTUNITY SITUATION AUDIT

PROGRAM OPPORTUNITY NAME:

PRODUCT AREA:

DATE:

PREPARED BY:

PD&M

EXHIBIT IV

BUSINESS OPPORTUNITY SITUATION AUDIT

SMP FORMS*

E-2A - Customer program data/activities

E-2 - Company activities

I-2A - Financial data (sales, NBF, facilities
cost, etc.)

*SMP = Strategic Market Planning

PROGRAM/
OPPORTUNITY
NAME

PRODUCT AREA

GFY/CY	19										TOTAL
CUSTOMER ACQUISITION PLANS, AND MILESTONES:											

CUSTOMER FUNDING PROJECTION

AUTHORITY SOURCES OF EXTERNAL DATA

FORM 80A

SMP 10/10/79

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PROGRAM
OPPORTUNITY
NAME

PRODUCT AREA/VP

E-2

GOV'T FISCAL YEAR	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	TOTAL
GOV'T/CUSTOMER'S PHASING, MILESTONES & FUNDING																	
Company activities																	
GOV'T/CUSTOMER FUNDING PROJECTION																	

AUTHORITY/SOURCES FOR
EXTERNAL DATA

PROGRAM/
OPPORTUNITY
NAME

PRODUCT AREA

		CY	19	19	19	19	19	19	19	19	19	19	19	19	19	19	TOTAL
\$M	SALES AT STAKE																
	SALES (EXPECTED VALUE)																
	EARNINGS (AT %)																
	COST (SALES LESS EARNINGS)																
	BUY (INCLUDING IC/HO)																
	MAKE-NDAC-HB (VALUE ADDED)																
NBF REQ.	PROPOSAL (B&P) \$M																
	MANYEARS																
	IRAD \$M																
	MANYEARS																
	TOTAL NBF \$M																
	MANYEARS																
	REQUIREMENTS \$M																
	OTHER INVESTMENT \$M																
	TOTAL INVESTMENT \$M																
	COMPARATIVE DATA SOURCES																

FORM 12A

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EXHIBIT V

BUSINESS OPPORTUNITY SITUATION AUDIT

PROGRAM SURVIVAL CRITERIA

EXHIBIT V

PROBABILITY OF SURVIVAL CRITERIA

P SURV	EVALUATION CRITERIA
0.9	<ul style="list-style-type: none"> • VALIDATED/ACCEPTED NEED (E.G., SECDEF APPROVED MENS; OMB SUPPORT; LACK OF OPPOSITION CONSTITUENCIES) • ESTABLISHED MISSION/SYSTEM BUDGETARY LINE ITEM <ul style="list-style-type: none"> - APPROVED FOR FSD/PRODUCTION (P.E. 6.4 OR EQUIV.) - PRODUCTION FOLLOW-ON BUY • GOOD PROGRAM MANAGEMENT TRACK RECORD <ul style="list-style-type: none"> - ACCEPTABLE COST GROWTH - GOOD TECHNICAL PROGRESS - NO MAJOR RISK AREAS UNRESOLVED • CLEAR RSI POLICY • CONGRESSIONAL ACCEPTANCE/SUPPORT

EXHIBIT V

PROBABILITY OF SURVIVAL CRITERIA (CONT'D)

P SURV	EVALUATION CRITERIA
0.75	<ul style="list-style-type: none"> • ESTABLISHED MISSION/SYSTEM BUDGETARY LINE ITEM (FYDP DATA, P.E. 6.3 OR EQUIV) • APPROVED MENS (SECDEF OR EQUIV) • APPROVED FOR ADVANCED DEVELOPMENT/VALIDATION • ESTABLISHED CUSTOMER PROGRAM OFFICE • CONGRESSIONAL SUPPORT
0.50	<ul style="list-style-type: none"> • EXISTING MENS (NOT FORMALLY APPROVED) • RECOGNIZED DEFICIENCY/NEED • APPROVED FOR CONCEPT FORMULATION • TECHNOLOGY PROVIDES SIGNIFICANT CAPABILITY IMPROVEMENT • ESTABLISHED TECHNOLOGY BUDGETARY LINE ITEM (P.E. 6.1/6.2 OR EQUIV)
0.25	<ul style="list-style-type: none"> • FEASIBILITY QUESTIONS/ISSUES • AFFORDABILITY ISSUES • LACK OF RECOGNIZED NEED/MISSION • SIGNIFICANT POTENTIAL FOR POLITICAL ISSUES E.G., NATO ACCEPTANCE/TREATY INTERACTIONS/ENVIRONMENTAL PROBLEMS ETC., • CONGRESSIONAL OPPOSITION/CONTROVERSY

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EXHIBIT VI

CUSTOMER DOCUMENTATION REVIEW

- CHECK LIST -

- STATE OF THE UNION ADDRESS
- OVERVIEW/POSTURE STATEMENTS
 - SECDEF
 - DR&E
- BUDGET REQUEST
- HEARING RECORDS
- COMMITTEE REPORTS
- CONFERENCE REPORTS
- THE CONGRESSIONAL RECORD
- GAO REPORTS
- SPEECHES/PRESS CONFERENCES/RELEASES
 - CONGRESS/CONGRESSIONAL STAFF
 - OMB
 - DEPARTMENTAL EXECUTIVES (I.E., DOD, HEW, DOE, DOI, ETC.)
- NEWS MEDIA
- PROFESSIONAL/TRADE JOURNALS

EXHIBIT VII

GOVERNMENT REGULATIONS REVIEW

- REPRESENTATIVE CHECK LIST -

- ENVIRONMENTAL IMPACT
- POLLUTION CONTROL
- LOCAL PLANNING AGENCIES
- LOAN GUARANTEE CRITERIA
- EXPORT LICENSE
- CONSUMER AGENCY CRITERIA
- PRODUCT LIABILITY REQUIREMENTS

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EXHIBIT VIII

CRITERIA FOR EVALUATION OF COMPETITIVE POSTURE

EXHIBIT VIII

PROBABILITY OF HDAC SUCCESS

P _{WIN}	EVALUATION CRITERIA
0.75	<ul style="list-style-type: none">• <u>EXCEPTIONAL COMPETITIVE POSITIONING</u>• LIMITED NUMBER OF QUALIFIED COMPETITORS• "UNIQUE/LEADING" SYSTEM CAPABILITY OR SOLUTION• STRONG OVERALL TECHNICAL POSTURE• RECORD/RAPPORT• GOOD CRAD TRACK WITH CUSTOMER• COST EASILY WITHIN COMPETITIVE RANGE (RATES AND TOTALS)
0.5	<ul style="list-style-type: none">• <u>"AVERAGE" COMPETITIVE POSITIONING</u>• NUMBER OF QUALIFIED COMPETITORS OR "HEAD-ON" WITH EQUIVALENT COMPETITOR• "GOOD" SYSTEM CAPABILITY OR SOLUTION• CAN AND DID PERFORM IN COMPETITIVE COST RANGE• GOOD SUPPORT WITH CUSTOMER• SOLID CAPABILITY IN KEY TECHNOLOGIES

EXHIBIT VIII

PROBABILITY OF HDAC SUCCESS (CONT'D)

P _{WIN}	EVALUATION CRITERIA
0.25	<ul style="list-style-type: none"> • <u>MARGINAL COMPETITIVE POSITIONING</u> • LARGE NUMBER QUALIFIED/INTERESTED COMPETITORS • "MUNDANE/FOLLOWING" SYSTEM CAPABILITY OR SOLUTION • DEFICIENT CRAD TRACK RECORD WITH CUSTOMER <ul style="list-style-type: none"> - FAILURE TO WIN KEY CRAD - POOR PERFORMANCE ON CRAD WON • POOR IMAGE/DIFFICULT RELATIONSHIP WITH CUSTOMER • MARGINAL TECHNICAL CAPABILITY IN KEY TECHNOLOGIES • QUESTIONABLE CAPABILITY TO PERFORM AT COMPETITIVE BID LEVEL

Appendix C

IN-DEPTH RESOURCE MARKET RESEARCH: The Semiconductor Industry

The purpose of this chapter is to present excerpts from one example of an in-depth strategic study of a resource market and the value of that study to the prime contractor buyers. This information was selected from a study provided to a DOD prime contractor by the Integrated Circuit Engineering Corporation, entitled "Status 80."

Study Content and Sections

The study focused first on the business climate of the integrated circuit resource market and examined the impact of inflation, pricing, new products, inventories, investments, manufacturing resources, worldwide aspects of the industry, and captive supply arrangements. It then looked at consumption and foreign influences on the market in areas such as Japan, U.S. imports/exports, Western Europe, East Bloc countries, and the rest of the world.

Next the study examined the semiconductor market size and growth, products in microcomputers and microprocessors, prototyping systems, peripheral controllers, datacom ICs, and memories. The third section examined the demand end and its impact on the resource market. It looked at competing demand elements in electronic games and toys, television, TV informational services, automotive. Section four examined industrial customer demand issues, while section five focused on the military and aerospace market and the demand for selected IC components. This section also included supplier profiles on selected military/aerospace suppliers. Section six examined a marketing/technical profile of the top ten U.S. semiconductor suppliers, while section seven examined captive suppliers and the issues behind this move. Section eight then examined fabrication facilities of captive suppliers, and sections nine and ten looked at the economics of manufacturing and IC technology. This study provides the best example acquired in the survey of a broad, in-depth resource market economic and marketing study.

A main issue which thread throughout the study was the expectation of huge demand increases for ICs under the notion of "the smart everything" and the concept that IC application technology would place a demand for supplying ICs as integral devices in numerous products heretofore not using them.

Annotated Outline and Summary of the Study

1980 Business Climate

The study of the semiconductor resource market was cast in a setting of the overall business climate of which it is a part. This climate perspective compared 1980 with 1979. Key issues in the business climate and their impacts were: inflation, pricing, new products, inventories, investment, manufacturing resources, worldwide aspects, and captive supply.

The study indicated assumptions about the inflation rate and about the application of traditional learning curve pricing. It indicated the impact of spot shortages on product innovation, and the fact that inventories would be at a minimum because of shortages of parts.

Investment by foreign firms was seen as robust, and in some cases joint ventures with US partners will occur. The study noted a claim that the US is losing world market share because of a shortage in manufacturing facilities, and that Japanese sourcing would increase because of US users being unable to find sufficient volume from US sources.

Semiconductor technology is diffusing uniformly in the world, particularly as US firms develop manufacturing facilities abroad. The business climate of the eighties will also see significant growth of in-house supply, particularly for short run custom development and to keep up with the state of the art. The introduction concluded with a discussion of growth rates in supply. These data are shown in Exhibits I and II.

Exhibit I illustrates forecasts of US consumption. Consumption growth was 37 percent between 1979 and 1980 and it will continue at a rate of 23 percent through 1983.

The study examined the Japanese influence in the world and what influence the policies about imports and exports would have. The conclusion is that Japan is rapidly developing into an equal competitor in IC technology, and will seek a comparable share of the world market. US manufacturers claim to be willing to accept this role for Japan if inequalities in opportunities and tariff barriers are eliminated. A major aspect of this is shown in the import/export balance data shown in Exhibit IV. The section concluded with a discussion of Western Europe production and consumption, and that of other countries.

Military/Space Market

For the sake of brevity the study will skip over other sections in the semiconductor resource market study and focus on the military and space markets. The study contained detailed, in-depth data on commercial and industrial semiconductor user and producer markets.

Over the past couple of years, the military need for advanced high-technology solid-state ICs has become focused in the public eye. Because of the continued debate with regard to the SALT II treaty and other arms limitations agreements, a solution is in limbo. DOD is showing increased interest in LSI solid-state IC devices and this will be a key issue in force multiplication. The emphasis placed by the USSR on satellite space weaponry systems for reconnaissance, secured communication, and tactical deployment of nuclear warheads for reentry at selected targets, has created a need for closer cooperation between DOD and the semiconductor industry.

The study noted that key areas receiving attention in DOD and supported by semiconductor manufacturers are VHSIC, radiation-hardened technology for IC devices, and CCD (charge-coupled IC imaging devices).

EXHIBIT I

LOCATION	MILLIONS OF DOLLARS				
	1978	1979	1980	1981	1982
USA					
IC MERCHANT	3,238	4,620	5,636	7,330	8,792
IC CAPTIVE	1,344	1,940	2,580	3,400	4,080
IC TOTAL USA	4,582	6,560	8,216	10,730	12,872
DISCRETES	1,540	1,913	2,200	2,530	2,910
TOTAL SEMICONDUCTOR	6,122	8,473	10,416	13,260	15,782
EUROPE-WEST					
IC TOTAL	453	570	880	750	825
DISCRETES	960	1,020	1,080	1,150	1,220
TOTAL SEMICONDUCTOR	1,713	1,590	1,760	1,900	2,045
JAPAN					
IC TOTAL	1,195	1,470	1,850	2,220	2,660
DISCRETES	1,295	1,425	1,570	1,725	1,900
TOTAL SEMICONDUCTOR	2,490	2,895	3,420	3,945	4,560
ROW					
IC	482	673	728	943	1,127
DISCRETES	985	1,019	1,055	1,093	1,133
TOTAL SEMICONDUCTOR	1,467	1,692	1,783	2,036	2,260
TOTAL INTEGRATED CIRCUITS	6,712	9,273	11,474	14,643	17,484
TOTAL DISCRETES	4,780	5,377	5,905	6,498	7,163
TOTAL SEMICONDUCTORS	11,492	14,650	17,379	21,141	24,647

LOCATION	MILLIONS OF DOLLARS				
	1978	1979	1980	1981	1982
USA					
IC	3,720	4,740	5,330	6,360	7,450
DISCRETES	1,100	1,400	1,700	1,900	2,310
TOTAL SEMICONDUCTOR	4,820	6,140	7,030	8,260	9,760
EUROPE-WEST					
IC	1,180	1,700	2,290	3,190	4,030
DISCRETES	1,320	1,380	1,430	1,500	1,580
TOTAL SEMICONDUCTOR	2,500	3,080	3,720	4,690	5,610
JAPAN					
IC	1,150	1,560	2,140	2,630	3,310
DISCRETES	1,100	1,300	1,410	1,650	1,810
TOTAL SEMICONDUCTORS	2,250	2,860	3,550	4,280	5,120
ROW					
IC	700	950	1,500	2,040	2,500
DISCRETES	980	1,020	1,200	1,220	1,400
TOTAL SEMICONDUCTOR	1,680	1,920	2,700	3,260	3,900
TOTAL INTEGRATED CIRCUITS	6,760	8,950	11,260	14,220	17,290
TOTAL DISCRETES	4,500	5,080	5,740	6,270	7,100
TOTAL SEMICONDUCTORS	11,240	14,020	17,000	20,490	24,390

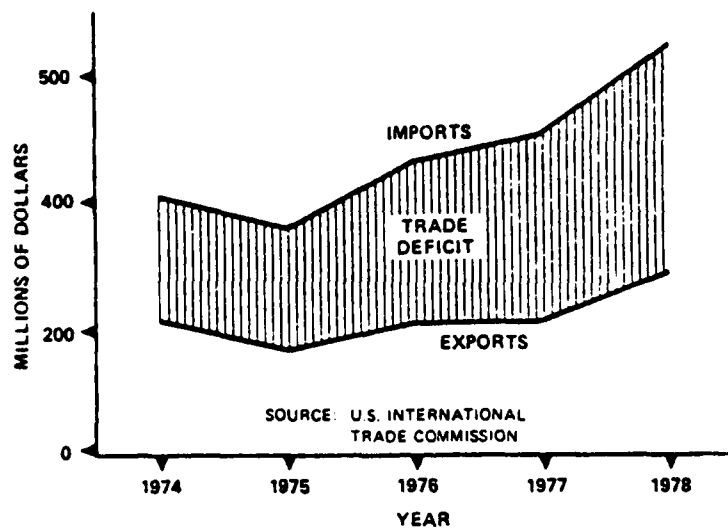
EXHIBIT II

	1978	1979	1980	1983
DISCRETES (INCLUDING OPTOELECTRONICS)	1243.1	1377.6	1484.2	1953.0
INTEGRATED CIRCUITS	2694	3684	4876	9121
MOS	1271	2000	2871	6135
BIPOLAR	1409	1667	1950	2850
BUBBLES	14	27	55	138

SOURCE: ELECTRONICS MAGAZINE

EXHIBIT III

EXHIBIT IV



It also noted that the USSR is engaged in a program of making direct copies of US IC devices, although they are largely laboratory experimental units. It then examined what were termed several key programs underway with DOD support and the prime contractors involved in R&D efforts. It also noted that the manufacturing technology program supported by DOD agencies will take advantage of advanced state of the art wafer-processing technology.

Never before in the history of the US have strategic military implications with regard to national security been more dependent on the design, manufacturing, and application of high technology ICs than now, says the study. Exhibit VI illustrates some of the customer/supplier linkages and lines involving technologies.

The study provided an analysis and presentation of the VHSIC program and its product/technological implications for suppliers. A synopsis is provided in Exhibit VII. Several strategic questions coming out of the military interest in VHSIC which are raised in the study are:

- (1) Will the VHSIC program further aggravate present manpower shortages in the IC industry?
- (2) Could the VHSIC program greatly help a few companies and skew the marketplace?
- (3) Will a commercial market develop?

It also presented a discussion of potential teaming combinations in IC technology, as is shown in Exhibit VI .

Supplier portfolios are an important part of strategic resource market management, and although the ones used in this study were not too thorough, they were much more detailed than was the case found with most of the prime contractor companies. Supplier strategic profiling is just becoming recognized as an important materials management factor, and few companies are as yet utilizing it. Some of these profiles are presented in Exhibit V as illustrations.

EXHIBIT V

U.S. SEMICONDUCTOR MANUFACTURER	PRODUCT/TECHNOLOGY										
	DoD AGENCY SUPPORT	JAN 32510 (B)	JAN 38510 (S)	ES SUB- MICRON	CUSTOM LSI-VLSI	CO. RACS	HMOS	SOS	PL	GrAs	OVERALL RATING
TI+	S	S	A	S	W	S	W	W	S	S	S
MOTOROLA+	A	A	W	A	A	W	S	W	A	N/A	A
FAIRCHILD+	A	A	W	S	W	S	W	W	S	N/A	A
NATIONAL*+	S	S	S	S	W	A	A	W	A	N/A	S
SIGNETICS+	S	S	S	S	A	S	W	W	S	N/A	S
HARRIS*	S	S	S	A	S	S	A	W	W	N/A	S
PMI	S	S	A	N/A	N/A	S	N/A	N/A	W	N/A	A
AMD	A	S	A	W	W	A	A	W	W	N/A	A
AMI+	S	A	W	N/A	S	S	S	W	W	N/A	A
INTERSIL+	W	A	W	W	A	A	W	W	W	N/A	W
INTEL	W	W	W	A	W	S	S	A	W	N/A	W
SILICONIX	A	A	A	W	S	S	W	W	W	N/A	A
RCA*	A	A	S	A	A	S	W	S	W	S	A
MMI	A	A	A	W	W	A	N/A	W	W	N/A	A
ROCKWELL*+	S	S	W	S	S	S	A	S	W	S	S

KEY S=STRONG
A=ACCEPTABLE
W=WEAK/NON-EXISTENT
N/A=NON-APPLICABLE

+ = SUPPORT OF THE VHSIC PROGRAM
* = RAD HARD PROGRAM

EXHIBIT VI

SYSTEMS MANUFACTURERS	U.S. SEMICONDUCTOR MANUFACTURERS	TECHNOLOGY
1. TEXAS INSTRUMENTS	1. TEXAS INSTRUMENTS	MOS N-CHANNEL
2. HUGHES AIRCRAFT	2. SIGNETICS	PL
3. ROCKWELL	3. SANDERS ASSOCIATES	C-MOS, SOS, MOS, N-CHANNEL
4. WESTERN ELECTRIC	4. WESTERN ELECTRIC	C-MOS, SOS, MOS, N-CHANNEL
5. TRW/UNIVAC/GCA	5. MOTOROLA	C-MOS, MOS, N-CHANNEL, BIPOLAR
6. RAYTHEON	6. FAIRCHILD	ECL, CCD
7. BURROUGHS	7. HARRIS	C-MOS, BIPOLAR
8. WESTINGHOUSE	8. NATIONAL	C-MOS, BIPOLAR
9. GE	9. INTERSIL	C-MOS, BIPOLAR
10. SINGER	10. AMI	N-CHANNEL, MOS
11. BOEING, UNIV. UTAH	11. GI	N-MOS, BIPOLAR
12. HONEYWELL	12. HONEYWELL	BIPOLAR
13. LOCKHEED	13. SRI INTERNATIONAL	SOS/CMOS
14. HARRIS SYSTEM	14. HARRIS SEMICONDUCTOR	SOS/CMOS

EXHIBIT VII

SELECTED SEMICONDUCTOR SUPPLIER
Business Profiles

Texas Instruments:

TI continues to support the MIL-M-38510 JAN integrated circuit program, both Class B and Class S. TI has been a leader in the utilization of electron-beam mask-projection systems that will be a major factor in providing complex device geometries in the submicron feature size as required for the VHSIC program.

National Semiconductor:

National continues to maintain its position as a major supplier to the military/aerospace market. National will continue to take advantage of its position as a major supplier of radiation-hardened CMOS and radiation-hardened integrated circuits. It has had a major investment to support the VHSIC program and is one of the few suppliers presently in possession of both VLSI and rad-hard capabilities.

Fairchild Semiconductor:

Fairchild has realigned its bipolar military operations and has established within that operation the bipolar SLI military hi-rel strategic business unit, with emphasis to be placed on bipolar memories and RAMs. Fairchild plans to participate in the VHSIC program.

Signetics:

Signetics continues to be an effective supplier of military/aerospace high-reliability products and is a major participant in the Class S space parts 38510 program. Signetics intends to participate in the VHSIC program, teaming with Hugues, utilizing Signetics injection Schottky logic process. It continues to secure qualifications to MIL-M-38510 for its linear analog bipolar devices and also continues to be a major supplier of bipolar PROMs to the military/aerospace marketplace.

Other profiles were also given on Motorola, Advanced Micro Devices, Harris, Intersil, RCA, and Rockwell. Exhibit provides examples of in-house technologies located at military/aerospace system houses.

Over the past decade, the military contractors have been unable, according to the study, to use captive IC facilities effectively for production of ground-based computer equipment. For the next decade, there is a growing realization that the integration level of military components will have to be raised significantly... to take advantage of the enhanced reliability and lower costs associated with VLSI. The VHSIC program is aimed at this objective, but contractors will continue to use a number of approaches, including standard-part design, customer design with outside manufacturing, and in-house design and manufacture.

Exhibit VII provides a listing of the US based IC manufacturers and their world sales. The list focuses on free market production. Captive suppliers, on the other hand, have certain advantages and disadvantages as illustrated in Exhibit IX .

Two major trends are becoming more apparent in the IC manufacturing business. First, the factory cost and the selling price on a per-function or per-unit basis are drastically decreasing with each succeeding technology and design. Second, to obtain this cost reduction, the capital equipment investment to perform the manufacturing operations is increasing at a rate of 20 to 25 percent per year, and will continue to do so for several years.

To obtain lower cost per function, a higher photomask resolution is required. To obtain this, capital equipment depreciation corresponding to as much as \$50 to \$60 per wafer will be required to meet the submicron processing capabilities. The report looks at key issues influencing and the outcome projections on wafer cost, and the economics of production module costs (See Exhibit X). Other important manufacturing data and strategies are also discussed relative to what will occur in the resource market and its impact on IC cost.

Finally, technology is discussed. Several IC technologies are competing on an almost equal footing in each of several application markets. CMOS and NMOS are gaining ground in classical bipolar linear applications and in high-speed digital products. Certain variations of bipolar technologies are competing on a circuit-density basis with MOS. This section continues to explore technological competition trends and issues. Exhibit XI provides forecasts of technology market share through 1986 in the resource market.

EXHIBIT VIII

SUPPLIER	MILLIONS OF DOLLARS								
	1978			1979			1980		
	MOS	BI-POLAR	IC TOTAL	MOS	BI-POLAR	IC TOTAL	MOS	BI-POLAR	IC TOTAL
AMD	87	63	130	120	87	207	165	110	275
AMI	71	—	71	94	—	94	110	—	110
ANALOG DEVICES	13	27	40	28	39	65	44	47	91
CHERRY	—	8	8	—	9	9	—	10	10
COMMODORE	18	—	18	28	—	28	34	—	34
ELECTRONIC ARRAYS	8	—	8	(14)	—	(14)	(18)	—	(18)
EXAR	—	9	9	—	15	15	—	20	20
FAIRCHILD (SCHLUMBERGER)	79	206	285	104	255	370	120	305	425
GI	70	—	70	90	2	92	115	3	118
HARRIS	32	54	86	55	65	120	73	77	150
HUGHES	8	6	12	8	8	16	12	10	22
INTEL	280	20	300	430	30	460	565	35	600
INTERSIL	40	14	54	60	18	78	65	19	84
MARUMAN	8	—	8	12	—	12	15	—	15
MICRO POWER SYSTEMS	9	2	11	9	3	12	10	4	14
MONOLITHIC MEMORIES	—	34	34	—	41	41	—	62	62
MOSTEK (UTI)	130	—	130	220	—	220	270	—	270
MOTOROLA	180	185	365	295	225	520	380	275	655
NATIONAL	125	185	310	230	260	490	295	295	590
PRECISION MONOLITHICS	—	15	15	—	23	23	—	29	29
RCA	80	50	130	85	80	165	98	92	190
RAYTHEON	—	27	27	—	32	32	—	37	37
ROCKWELL	80	—	80	105	—	105	120	—	120
SEMI (GTE)	29	—	29	22	—	22	31	—	31
SOLID STATE SCIENTIFIC	19	—	19	28	—	28	32	—	32
SIGNEFICS	33	172	205	50	200	250	65	250	315
SILICON GENERAL	—	6	6	—	12	12	—	18	18
SILICONIX	18	9	27	26	10	36	30	13	43
SPRAGUE	—	20	20	—	23	23	—	25	25
STD MICRO SYSTEMS	10	—	10	15	—	15	19	—	19
SUPERTEX	6	—	6	7	—	7	10	—	10
SYNERTEK (HONEYWELL)	34	—	34	50	—	50	60	—	60
TELEDYNE	7	7	14	9	6	15	11	7	18
TRW	—	9	9	—	15	15	—	27	27
TI	205	405	610	350	557	907	440	600	1040
WESTERN DIGITAL	8	—	8	14	—	14	22	—	22
ZILOG	10	—	10	18	—	18	21	—	21
OTHERS	11	11	22	26	8	34	20	8	28
TOTALS	1686	1544	3230	2586	2034	4620	3252	2378	5630

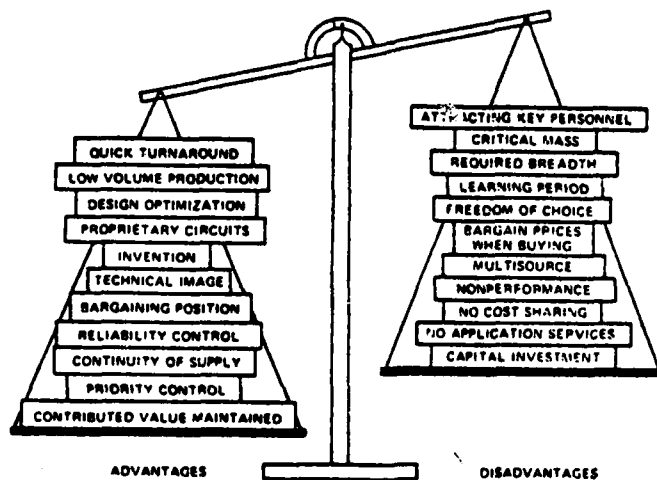


EXHIBIT XX

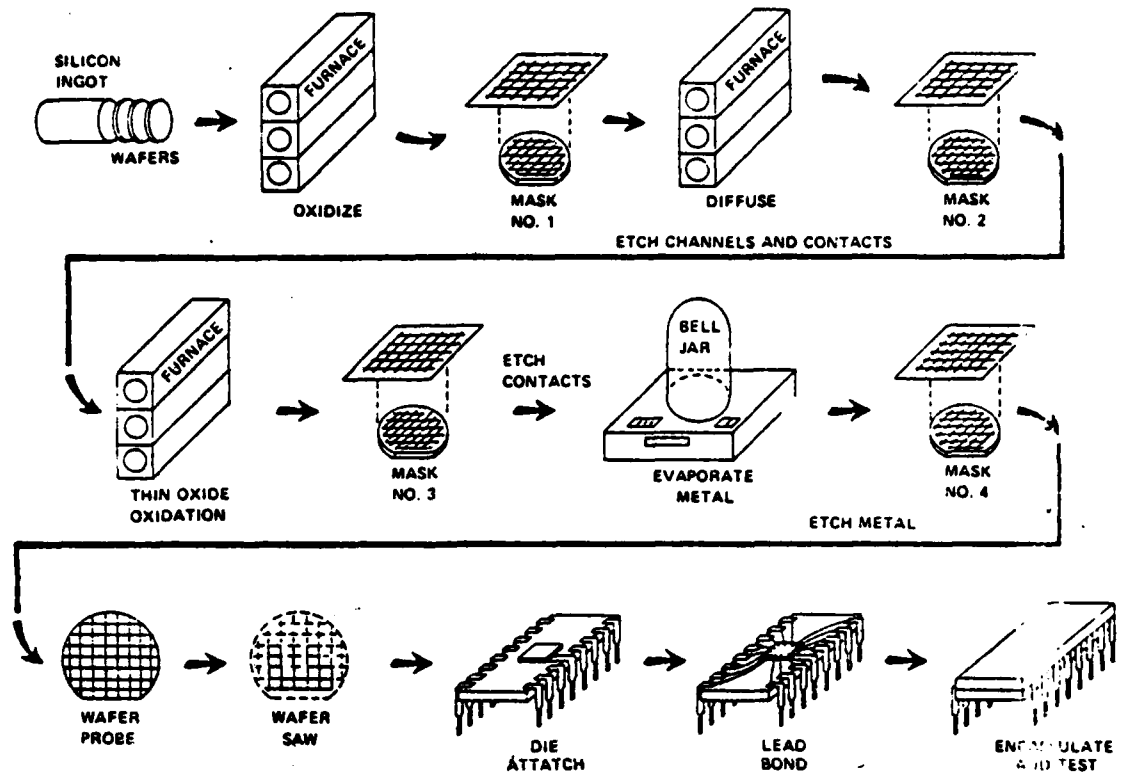


Figure 9-2
Manufacturing Sequence for a Single Integrated Circuit

1. WAFERS PER SHIFT (4" MOS WAFERS, 3-4 MICRON RESOLUTION, 2-SHIFT OPERATION)		500 WAFERS	
2. BUILDING AREA		50,000 SQ. FT.	
3. TOTAL PERSONNEL (2 SHIFTS)		275	
4. INVESTMENT	ASSET LIFE		DEPRECIATION COST PER WAFER
BUILDING	25 YRS.	\$ 2,000,000	\$ 0.32
LAND (10-20 ACRES)	—	800,000	—
WAFER FAB EQUIPMENT	5 YRS.	9,000,000	7.20
TEST EQUIPMENT—QC **	5 YRS.	2,000,000	1.60
LEASEHOLD IMPROVEMENTS	10 YRS.	1,400,000	0.56
TOTAL INVESTMENT		\$15,200,000	\$ 9.68
5. ANNUAL FACTORY OPERATIONS COSTS (2 SHIFTS)			
LABOR—WAFER FABRICATION		\$ 4,500,000	\$18.00
LABOR—ADMINISTRATION ENGINEERING		3,000,000	
MATERIALS—(WAFERS)		3,000,000	12.00
SUPPLIES—WAFER FABRICATION		2,000,000	8.00
TOTAL FACTORY OPERATION COST		\$12,500,000	\$78.00

*1980 COSTS—CURRENT INFLATION RATES AND TECHNOLOGY IMPROVEMENTS WILL
INCREASE COSTS BY 20%-25% PER YEAR

**PRODUCT DEPENDENT

EXHIBIT X

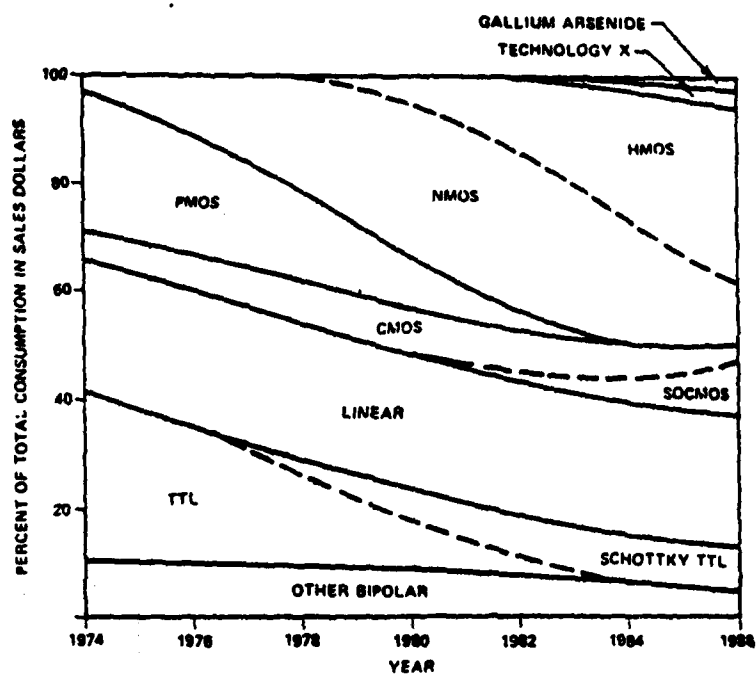


EXHIBIT XI

APPENDIX D

STRATEGIC MANAGEMENT ORGANIZATION

This appendix sets forth examples and charts regarding organization of the strategic management function, with emphasis on strategic planning, manufacturing planning, and procurement planning.

Organizational Concepts

This section was taken from a report by an electronics supplier of DOD and contains a perspective on organizational concepts regarding strategic planning.

On many systems production lasts many years, and one government product that we sell has lasted for twenty years. Typically, the life cycles for defense and commercial electronics systems is about 12-15 years. This provides us a large production base in our long range planning.

There are also follow-on systems in development. So we have a fairly stable production base, although new products are added from time to time. They are in development for a number of years prior to production. Typically, we apply a large technology base to these programs from a wide product mix that we maintain.

In our company, the procurement function is organizationally fit under "operating services." It is considered as an operating function to support manufacturing. Although we have rather little long-range procurement planning relative to suppliers, we do have a manufacturing technology strategy for the long-run and overhead-related manufacturing technology plans are included. However, manufacturing technology also comes under operating services, so you really can't consider operating services as a short-range, tactical function entirely.

The next level below the division is what we call the "product customer center." This is an organizational concept that we use. These centers have full responsibility for creating, producing, and marketing products drawing on functional support from various organizations. This really gives us alot of smaller companies with a group function to coordinate them.

Our planning program functions within this organization to provide objectives for the corporate and group activities and strategies for each division. Plans for each year are made for each project in a center based on a zero base budgeting activity. We expect our managers to wear two hats: operating had, planning hat. Managers have a written document for each level of planning for objectives, strategies, and tactics, and are measured on growth and on asset return.

We set ten year goals with full financial plans and details on investments required, assets required, and profit forecasts on programs.

The key focus is on what we term "Served Available Markets (SAM)." It is a term for what we consider the "market that we serve." We measure ourselves on the share of that market we have with the intent of increased penetration. Thus, the objective is based around the idea that the larger the share we have, the more benefit there is from common materials, shared experience, and reduced cost.

Our strategies are reflected in milestones relative to that served market at decision points over ten years. Tactics are planned and funded each year by program aimed at these available markets. We hold a corporate review of all these to provide as much synergism as possible. The short-range activities are judged on their profitability, but strategic activities are required to invest for the future and we must have a balance.

There is internal competition for resources, based on zero base budgeting, such as in the area of assignment of people and of funding support. Managers are measured on operating activities up through the organizations, strategic expense for R&D for new products, and on total organization profit.

The mix of business between short term and long term varies between managers, depending on their orientations and the facts at hand. We consider R&D investments as a strategic expense, separate from other expenses, including IR&D for government and commercial programs.

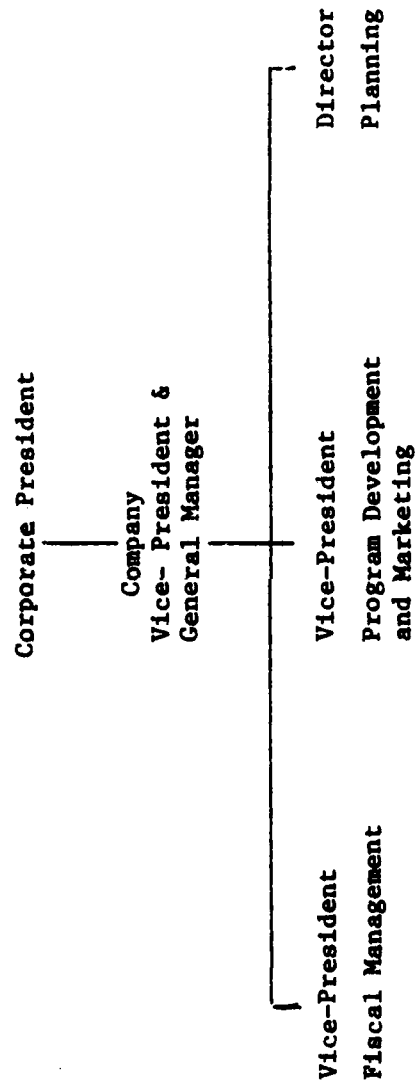
In planning, we try for product/technology leverage, and we can get leverage off products across programs to benefit the overall business. Financial planning to support this leverage comes through monthly forecasts for one year or more with detailed review of all indices for a manager.

Every organization within the company has a model of how that business should run optimally and the levels it should have in such areas as billings, sales, material and labor shopload forecasts, overhead, profit margins, strategic investments in new products and technologies, people, capital forecasts, and others.

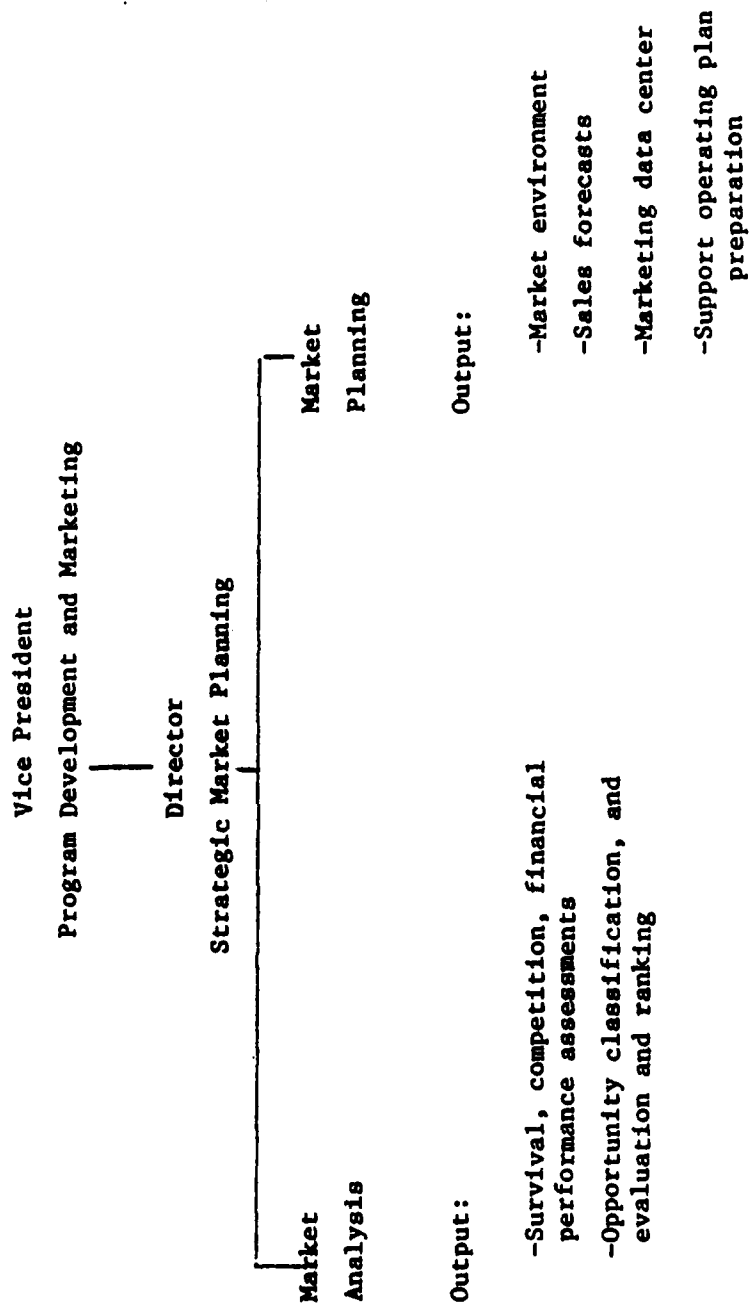
The key indices used to judge managers include billings growth and investments in objectives, strategies, and tactics.

The remainder of this appendix presents various organization charts for the strategic planning and management function.

ORGANIZATIONAL LOCUS OF PLANNING FUNCTION



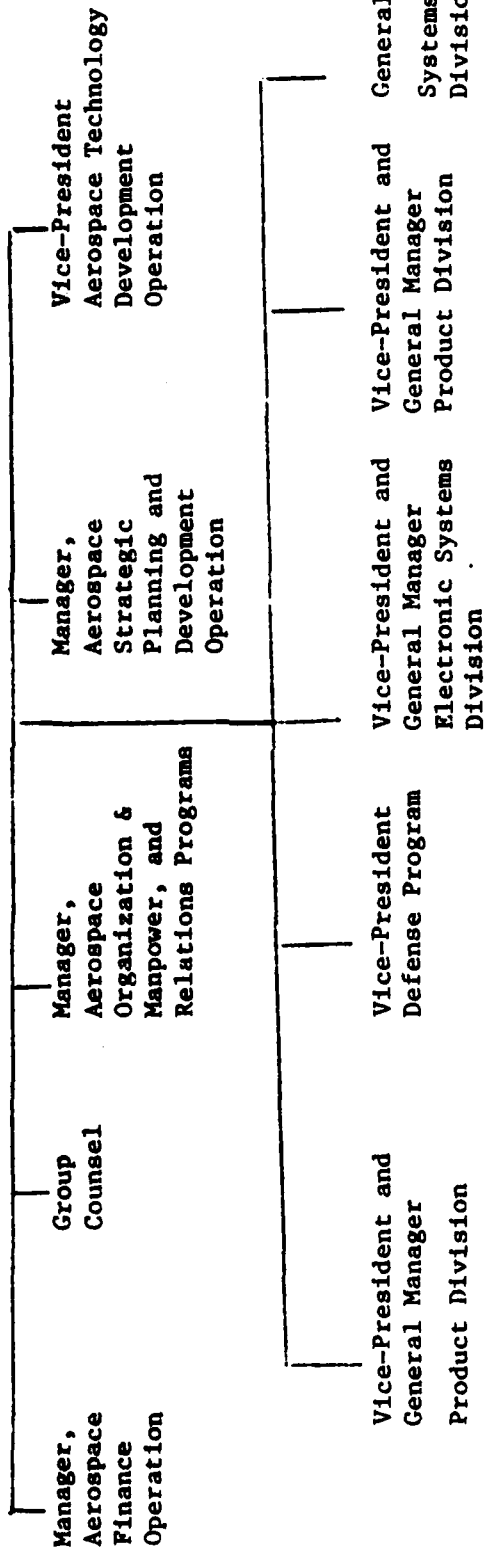
ORGANIZATION OF STRATEGIC MARKET PLANNING



ORGANIZATION CHART OF AN AEROSPACE GROUP

Senior Vice-President &

Group Executive



**General Electric Company
CORPORATE ORGANIZATION CHART**

Corporate Executive Office

<u>Corporate Components</u>			<u>Corporate Executive Office</u>		Office of General Counsel
Corporate Financial Staff (Sr. VP)	Corporate Executive Manpower Staff (VP)	Corporate Production & Operating Services (Sr. VP)	Corporate Technology Staff (Sr. VP)	Corporate Planning & Development Staff (Sr. VP)	

Operating Components

Consumer Products & Services Sector	Industrial Products & Components Sector	Power Systems Sector	Technical Systems & Materials Sector*	International Sector	Affiliate Company (Subsidiary)
--	--	----------------------------	--	-------------------------	--------------------------------------

Organizational Breakout:

Aerospace Business Group*

Aerospace Technology Development Operation
Aircraft Equipment Division*
Electronic Systems Division
Reentry Systems Division
Space Systems Division

*Strategic Plans are developed
at each of these levels plus at
Strategic Business Unit (SBU) level.

Aircraft Engine Business Group*
Commercial Engine Operations
Military Engine Operations
Aircraft Engine Engineering Division
Aircraft Engine Manufacturing Division*

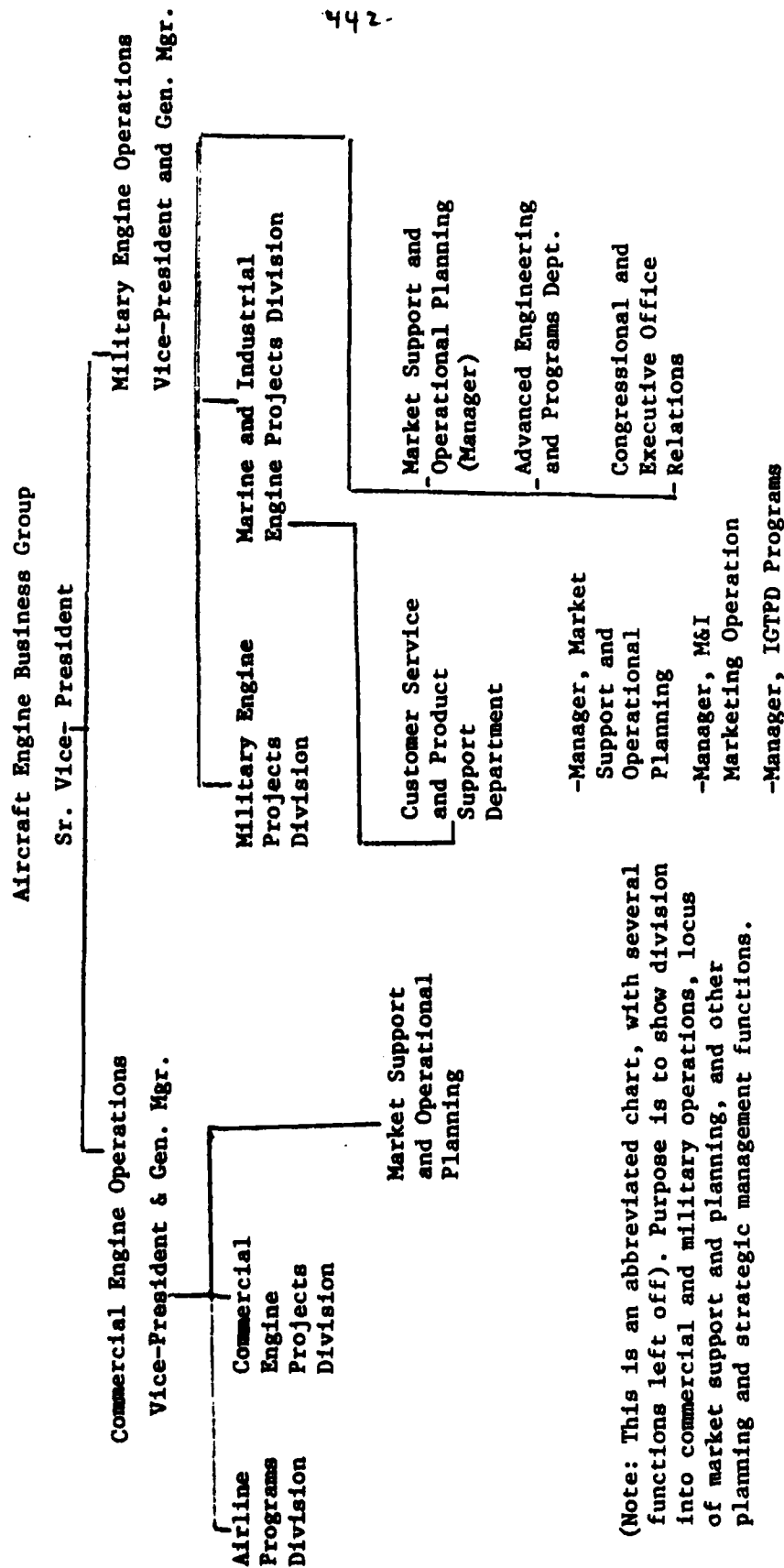
(Long range functional
operating plans)

Engineered Materials Group
Materials Divisions

Information and Communication Systems Group
Product/Market Divisions

Medical Systems Business Division

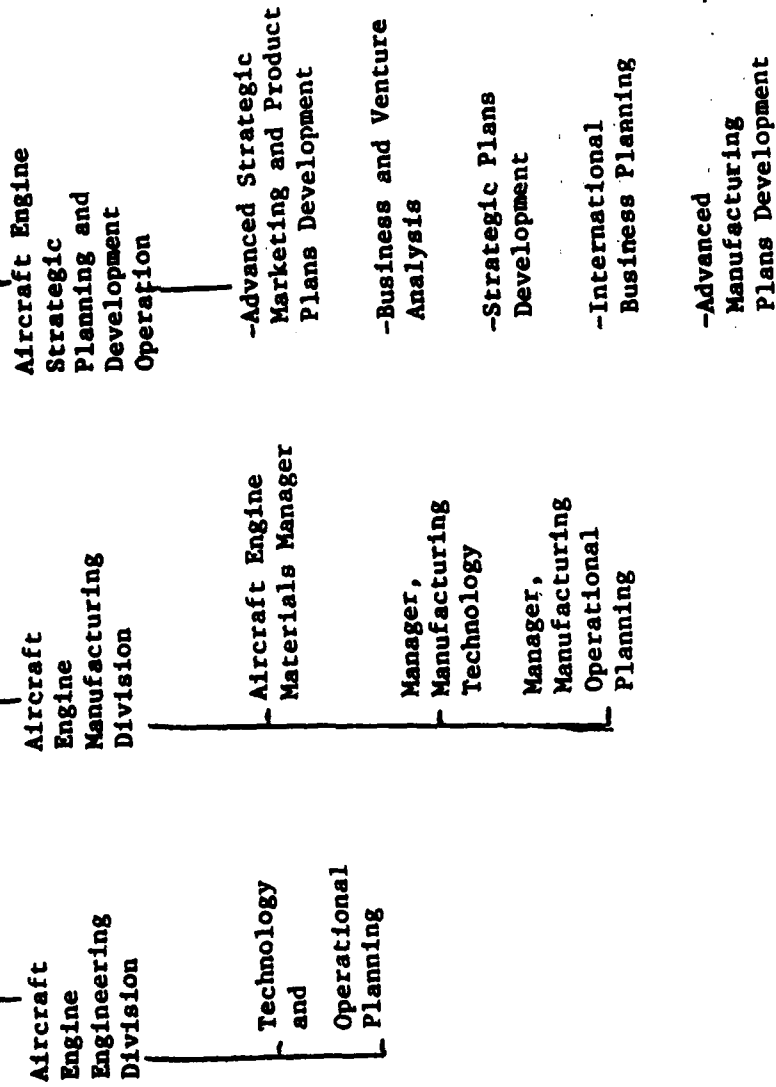
General Electric Company
Aircraft Engine Business Group Organization



(Note: This is an abbreviated chart, with several functions left off). Purpose is to show division into commercial and military operations, locus of market support and planning, and other planning and strategic management functions.

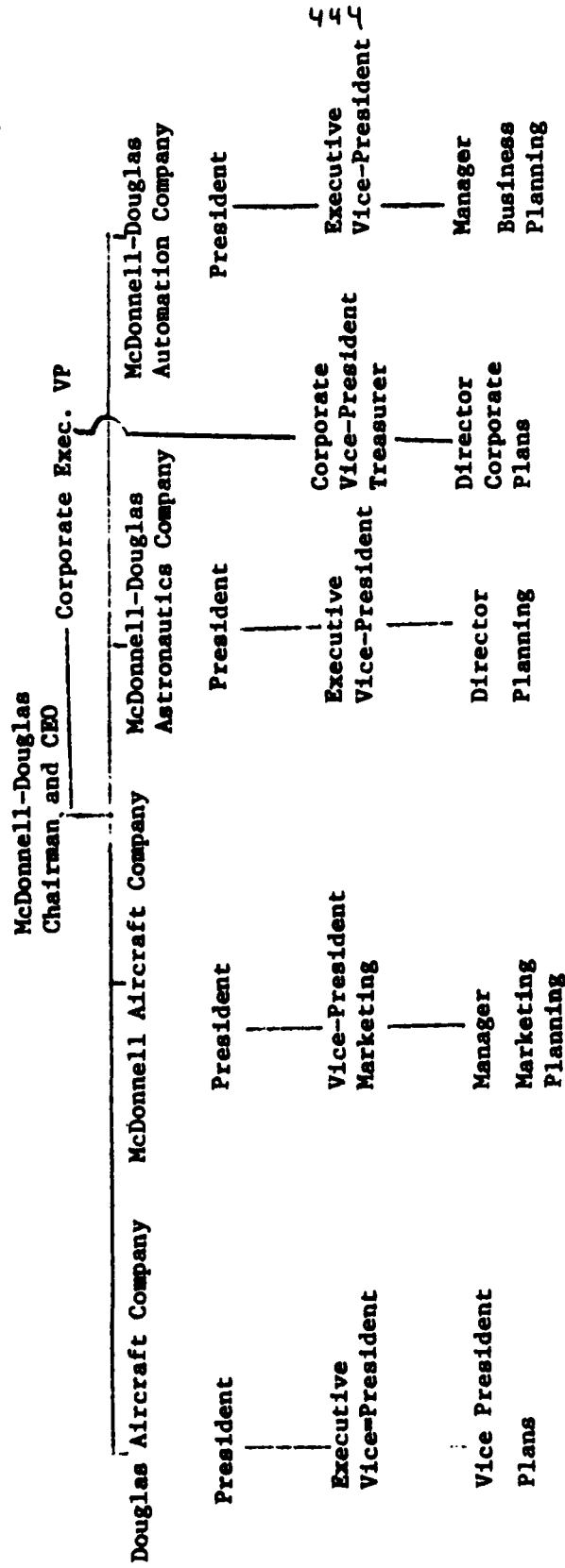
General Electric Company
 Organization Chart
 Aircraft Engine Business Group

Sr. Vice President

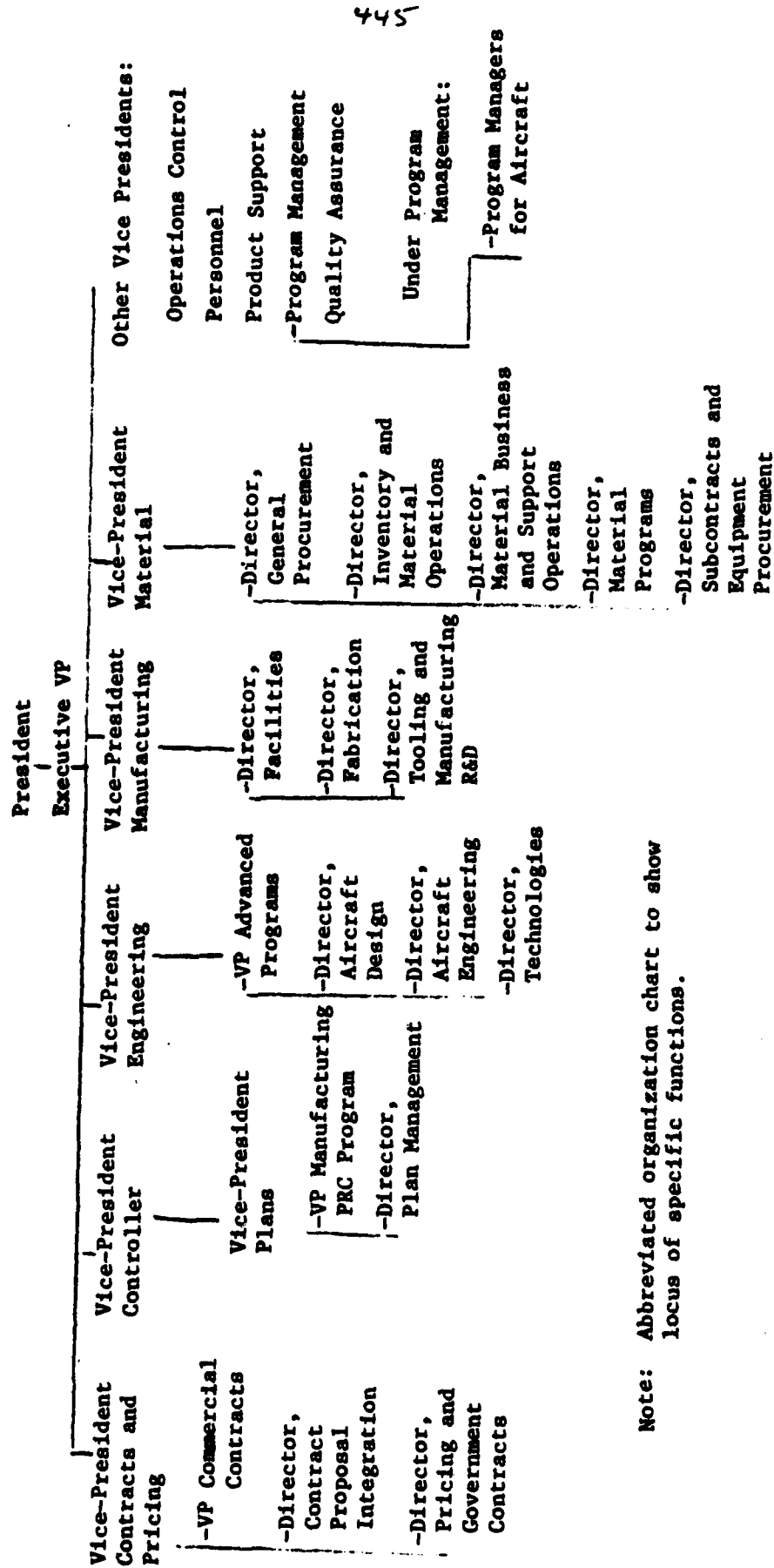


Note: Abbreviated organization with several functions deleted. Merely shows the organization of the engineering and technology planning, manufacturing and materials, and strategic marketing and business plans development.

McDonnell-Douglas Corporation
Overall Planning Organization



Douglas Aircraft Company
Organization Chart



Note: Abbreviated organization chart to show
locus of specific functions.

4-5